THE

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

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THE ROYAL ENGINEER ELECTRICAL ENGINEERS.

WE are able this week to present our readers with some illustrations and a description of the plant taken out to South Africa by the above corps. The first contingent, it will be remembered, consisting of 58 men and six officers, started for South Africa on March 16th, under the command of Captain Lloyd, R.E.

It took with it then a complete equipment of two search-light trains, each train consisting of two wagons, each carrying 4 tons, and one traction engine with its dynamo, as well as one spare dynamo. In addition, 24 arc lamps with portable lanterns, together with 200 incandescent lamps, were taken out.

Further, some cycles, to which we refer in another place, were taken out to work in connection with the telephones, which were intended for facilitating communication.

A second contingent, consisting of about 10 men, under Major Crompton himself, sailed for the seat of war on April 14th, and took with it a third traction engine.

We understand that Major Crompton has gone out with instructions from the War Office to proceed direct to the front, and to place himself at the disposition of Field Marshal Lord Roberts with regard to certain problems dealing with electricity in the field, and with the question of transports generally in South Africa.

The War Office have thought so highly of Major Crompton's scheme for working the transport service of an entire division of the Army, independently of all railways, that they have instructed him to proceed at once to explain the scheme to Lord Roberts, and to obtain any further information necessary for putting it into execution.

Major Crompton is well known to all of our readers as one of England's eminent engineers, yet the fact may not be as well known that long before electrical work crossed Major Crompton's path he was actively engaged for nine years for the Indian Government in experimenting on road traction, and the experience then gained places him in a unique position to undertake any work in connection with the application of mechanical power both for electrical and transport purposes. Whilst on the one hand, the War Office is to be congratulated on having enlisted the services of so able an engineer, on the other hand, the electrical profession cannot overlook the compliment that one of its members has been called upon to give expert advice on a subject which he has made a special study.

The fitting out of the present plant has been no small matter, and everyone conversant with the designs hitherto made use of for work of this description will at once recognise the improvements introduced in the present equipment.

Hitherto the field projector was like a ship projector carried on ordinary wagons. Compare this combination

with the present plant, and the improvement will be at once appreciated.

It may be of interest to point out a few of the uses to which a plant of this description can be put.

In addition to the work which can be done by projectors in the way of signalling and reconnoitring at night, the same plant can also be made use of for lighting up camps or depôts, by means of either arc or incandescent lamps. Further, the traction engine can be used for ordinary transport purposes; and it is surprising what rough country a light engine of this description will cross.

Then again, the traction engine and dynamo can be used for generating power for one of the dynamos turned into a motor. It is quite likely that some uses may be found for this application. The motor is not a heavy thing to haul to the top of a kopje, and here, in conjunction with a simple winch arrangement, it may be made use of for hauling up guns or ammunition. In a similar way the motor may be taken across a river, and wagons or materials for a bridge may be hauled across. Lastly, the bicycles and telephones will be useful for facilitating communication.

These are some of the most simple applications, though several novel ideas have been suggested by Major Crompton for extending their usefulness in war time; these will no doubt be tried if an opportunity occurs, but, in the meanwhile, we are not at liberty to publish them.

Tenders *v.* Contractors.

THERE can be no reason to doubt that competition in electrical contracts grows at an alarming rate, and a study of any list of tenders will show that there is an increasing number of new firms. It is always more or less difficult to draw conclusions from a mere list of prices, because variation in estimates is frequently due to differences in machinery, sometimes design, and at other times output; one can, however, discover some striking facts occasionally, and probably the most notable one in the tenders of the present day is the great number of alternative schemes that are usually presented. Generally speaking, an electrical contractor is not displeased at being given an opportunity to furnish alternative tenders, because it may enable him to quote for machinery which he can easily supply, but one can have too much of a good thing, and when one sees electrical firms sending in as many as four different schemes, it might appear that there is some slight abuse of the system of tendering. A very striking example of this practice has recently arisen in the case of a public institution requiring an electrical lighting scheme. Probably the value of the steam engines, pipe work and dynamos, was about £7,000, which probably would not yield an excessive amount of profit to a contractor who only manufactured one section of the plant which had to be supplied. This fact, however, did not deter 34 distinct firms from furnishing estimates, and many of these gave three and four different tenders. We are not concerned at the moment with the total amount of time spent on preparing these schemes, nor with the convenience of the consulting engineer who has to read and consider them; at the same time, the fact must not be overlooked that if some 80 tenders are sent in for a comparatively small plant, consulting engineers must eventually either raise their fees or modify the system of tendering. Another curious feature, and what appears to us to be an altogether unnecessary one, is the amount of duplication that is going on. A dynamo manufacturer when sending in his estimate quotes for a certain class of engine, and being probably a well-known type, it is quoted by several other contractors who are also dynamo builders. That, however, is not considered sufficient, for the engine maker himself sends in his own estimate, and no doubt includes in his tender some well-known type of dynamo. As we have said, this is mere duplication, and must necessarily lead to a great waste of time. We admit it might be difficult to avoid this under some circumstances, nor do we think it an easy matter to suggest a remedy. There is, unfortunately, an excessive amount of sub-contracting in most electrical contracts, and as engine and dynamo construction have been always more or less looked upon as requiring distinct and separate organisations, this is not surprising. It is probable that this, however, is a species of specialising which is highly desirable in so complex an industry as the electrical. The modern form of tendering and manufacture do not often guarantee that responsibility and profit go together. Assuming that a firm of dynamo makers secure an order for lighting plant, they will in all probability purchase the engines, the pipe work will be let to sub-contractors, and in most cases the switchboard will be furnished by another sub-contractor. The manufacturing profit, therefore, must be obtained merely on the dynamo portion of the contract, though we doubt whether that is likely to be very great under the best of conditions; there are, of course, certain discounts on the engines and the other portions of the plant which the contractor does not make, and it is highly probable that in many contracts this is the principal source of profit. Disparity of prices is an old tale, nor are we hopeful of much improvement in this direction; there will be always the new firm which seeks advertisement through the medium of a low tender, at the same time, new organisations possessing the advantage of modern machine tools and low establishment charges will be able to reduce the price of machinery very materially.

Electric Motive Power for "Cottage" Industries.

THE Ungarische Electricität's Allgemeine Gesellschaft and the Budapester Allgemeine Electricität's Gesellschaft are about to make an experiment in the supply of electrical energy for power to those engaged in small industries, at an extremely low price. A workshop fitted with electromotive power is to be erected in the neighbourhood of their central generating station, and those engaged in any trade which requires only a small amount of power will be able to obtain electrical power at a very small cost. The project is at the moment the subject of negotiation between the company and the Minister of Commerce, and if the idea is put into a practical form, its development will be watched with much interest. The subject has been thoroughly ventilated in the Austrian journals, but hitherto its treatment has been purely theoretical, as the workers engaged in the industries to which the scheme would appeal have not had the means to instal the necessary electric motor in their little workshops. Statistics show that the introduction of electric power in the larger industrial applications is growing, but that so far its advantages do not appear to have been appreciated by the smaller industrial undertakings. The scheme of a central electrical workshop has this disadvantage, that the class of workers to which it is intended to appeal have their "workshop" in the same house, (if not room) as the one they live in, and their customers are nearly always people living in their immediate neighbourhood, and it is doubtful whether they will be persuaded to leave their present workshops and work in the central electric workshop by the inducement of cheap power. If the scheme included some arrangement whereby the expense of fitting up could also be charged for in instalments or by an increased rental for the power, the inducement would certainly be greater. The idea is not original. Somewhat similar workshops have been in operation for some time in Berlin. Several large buildings have been erected and divided up into large and small workshops fitted with electric power so that the tenant has not to fear the cost of installation. He pays a rent for the premises, and in addition pays for the current used. So far these ventures have been uniformly successful.

ELECTRIC LIGHT FITTINGS AT THE LONDON HIPPODROME.

Visitors to the new Hippodrome which has recently been opened in Leicester Square cannot fail to be impressed with the character of the electric light fittings which have been introduced. Their excellence of design and exquisite finish bring them into harmony with the splendour of the lavish furnishings of this place of entertainment. This remark applies equally to the public entrances as to the auditorium itself, for the care of the designer is apparent not only in the design of the fittings, but general artistic effect has influenced the fixing of their positions, every effort being made at the same time to secure the best results in the matter of illumination.

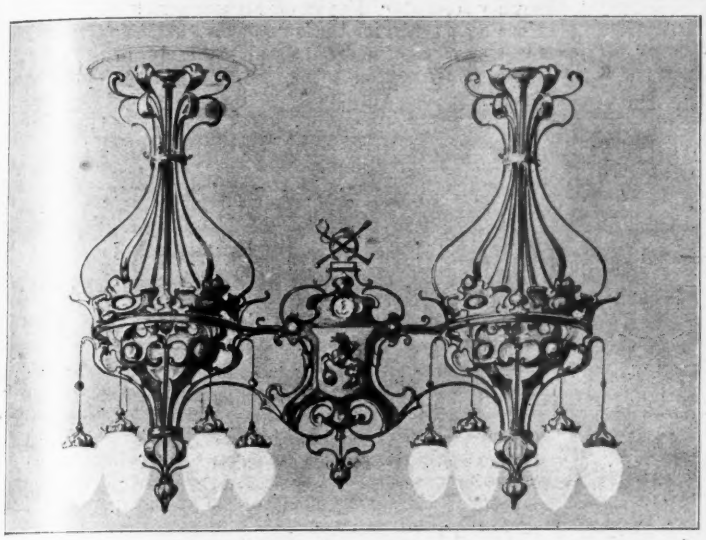


Fig. 1.

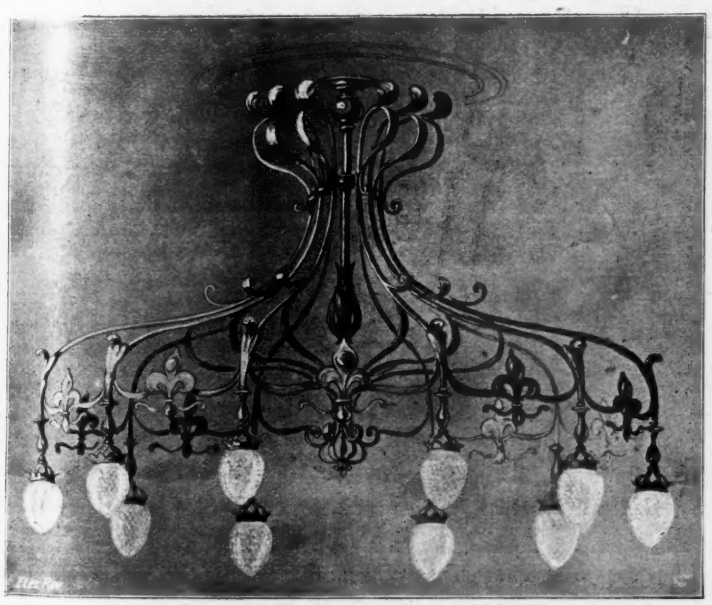


Fig. 2.

The grand entrance and *foyer* should, as a matter of course, come in for first mention. Here there are several very handsome *repoussé* electroliers.

Fig. 1 shows the double electrolier in the vestibule, which suspends from two small centre domes. In designing these electroliers special attention was devoted to the ornamentation, viz., that of rampant horses, so as to make them suggestive of the purpose for which the buildings were to be used. In this lobby there are also several very pleasing wall fittings in the form of candelabra, and a delicately shaded light over the booking office. The *foyer* has a large electrolier of somewhat similar design also suspended from the glass dome, as seen in fig. 2. On the right, here, is the saloon, which is fitted up and furnished as a ship's cabin. Among the various fittings which combine to produce a happy effect, there are two very handsome lanterns, which we are able to show in fig. 3. These lanterns are in the early English style, finished in antique brass, and are fitted with imitation horn cylinders, and altogether they beautifully harmonise with the peculiar surroundings of the cabin.

Turning our attention now to the auditorium, there are suspended from the central dome four very large brass electroliers (fig. 4; see next page) each having 40 16-c.p. incandescent lamps. They are each provided with a powerful winch for raising and lowering, to facilitate the replacement of lamps and general cleaning purposes.

Right above these the circular dome in the centre of the roof is outlined by 24 incandescent lamps suspended on ornamental brackets, immediately below them being 20 very richly cut-glass ceiling dishes set out in a square. Projecting from the lion's mouth in the slips on each side of the auditorium there is a very prettily designed brass electrolier with 12 16-c.p. lamps.

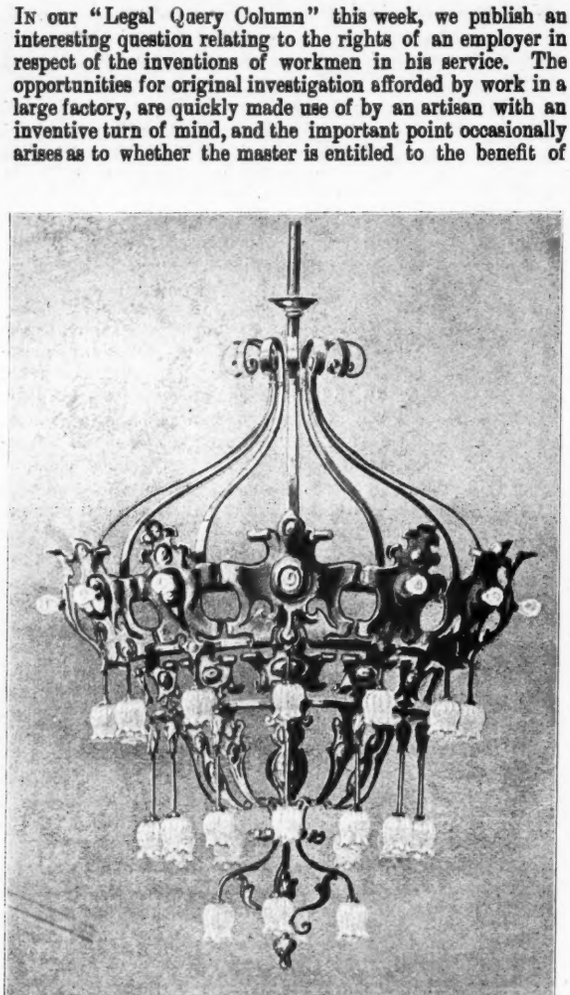
Fig. 3.

The whole of the work was carried out by Messrs. F. & C. Osler under the direction of Mr. E. Wingfield Bowles, who has acted as electrician to the Hippodrome authorities during the construction of the buildings, and to whom we are indebted for the loan of the drawings from which our illustrations are photographed down.

E

THE RIGHT OF AN EMPLOYER TO THE INVENTIONS OF HIS WORKMEN.

In our "Legal Query Column" this week, we publish an interesting question relating to the rights of an employer in respect of the inventions of workmen in his service. The opportunities for original investigation afforded by work in a large factory, are quickly made use of by an artisan with an inventive turn of mind, and the important point occasionally arises as to whether the master is entitled to the benefit of



Electric Light Fittings.—Fig. 4.

inventive genius fostered in his employment, and put into practice with means and apparatus supplied by him. According to the answer which has been appended to the query, it seems that a workman making a discovery under such circumstances is regarded by law as the "true and first inventor," and as such he is, of course, entitled to all the benefits which may accrue from the invention. The only remedy open to the employer under these circumstances is to bind his workmen over to surrender all inventions discovered by them during the period of employment.

It must not be supposed, however, that the valuable suggestions made by a workman when his master is experimenting with some new machine, remain the property of the workman, so as to defeat the master's right to obtain the grant of letters patent. A difficulty sometimes arises when the improvement assumes such importance as to make it difficult to say who, in fact, is the true inventor of the perfected invention; but mere mechanical alterations could hardly have such an effect. Upon this point the words of Erle, J., in Allen *v.* Rawson (1 C. B. 551) may be usefully quoted:—"I take the law to be, that if a person has discovered an improved principle, and employs engineers or agents or other persons to assist him in carrying out the principle, and they, in the course of the experiments arising from that employment, make valuable discoveries accessory to the main principle, and tending to carry them out in a better manner, such improvements are the property of the inventor of the original improved principle, and may be embodied in his patent, and if so embodied, the patent is not avoided by evidence that the agent or servant made the suggestions of that subordinate improvement of the primary and improved principle." Where it is impossible to say whether the master or the servant is the inventor, the Patent Office authorities would now, if either opposed a grant to the other, refuse the letters patent except in the form of a joint grant to both (Russell's Patents, 2 De. G. & J. 130).

In connection with this subject, it might be mentioned that communication to a workman by an inventor who contemplates taking out a patent is not "publication" in the sense that it will render the patent invalid through want of novelty (Gadd *v.* Mayor of Manchester, 9 R. P. C. 259). Nor does a single instance of manufacture of an article made by a workman under an injunction of secrecy for an inventor who is about to take out a patent avoid a subsequent grant.

THE PARIS EXHIBITION.

[FROM OUR SPECIAL CORRESPONDENT.]

Paris, *April 16th.*

The special interest of the Paris Exhibition of 1900 for readers of the Electrical Review is the fact that its promoters claim that it is the Apotheosis of Electricity. Throughout the vast extent of the buildings, we meet abundant evidence that the close of the nineteenth century is a period of the triumph of electrical science. Electricity is the heating power, the motive power, and the lighting power, while the combination of electrical inventions and commercial ingenuity provides the main part of the amusements of the immense crowds of visitors.

As we quitted the Presidential *cortège* on the 14th, we began to wonder whether after all the anti-Governmental organs were not right, and the opening had been "rushed" for political reasons. Wandering through gallery after gallery, encumbered with *débris* and packing cases, there seemed little to interest the quarter of a million visitors who passed the turnstile next day. But although there was practically not one complete exhibit, we soon discovered much that was of interest to the electrical visitor. We turned naturally in the first place to the Palace of Electricity. This immense and handsome building masks the Machine Hall at the top of the Champ de Mars, and occupies one of the most important and striking positions of the whole 75 acres which are covered by the Exhibition. The building is composed entirely of iron and glass, and has a length of 130 metres, whilst its highest point is 70 metres from the ground. The front is surmounted by an illuminated sign bearing the figures "1900," and an allegorical figure representing the Spirit of Electricity standing on a car drawn by winged horses, and brandishing in his hand the torch of Progress. The roof is formed as an arc of an immense circle composed of smaller arcs and sustained by pillars on either side, and presents a most graceful appearance. A sort of trellis-work carrying multi-coloured lamps and flags surmounts the whole. The *facade* is composed of zinc *repoussé* in the form of nine bays decorated with many coloured glasses and lamps. The whole palace is illuminated by 5,000 incandescent electric lamps of many colours, eight arc lamps with coloured reflectors and shades, and four very large reflecting arc lamps, and when the shades of night descend it will form a dazzling centre of illumination. The first, or lower gallery, is reserved for very heavy motors, and is illuminated day and night. The gallery above communicates by wide staircases with the lateral annexes of the palace, which form two more galleries of 30 metres in length. The central gallery, running above and between the two power houses, communicates directly with the Machine Hall and the magnificent Salle des Fêtes.

The Palace of Electricity is a combination with, and forms one building with, the Chateau d'Eau. Looked at from the Tour Eiffel, the buildings seem to form part of one immense front. The Chateau d'Eau, with its beautiful, vast, but incomplete cascade, stands in front of the Electrical Palace, but being of lesser height, forms a beautiful foreground to the higher palace behind. A large hemispherical

opening of 30 metres, with a depth of 11 metres, contains a series of basins disposed one above the other, from which the water descends in cascades to an immense lower basin. The ornaments are mostly gods and goddesses in Louis XV. style. From the centre of the vault a cascade of water 10 metres in breadth, pours out 1,200 litres per second. The water is pumped from the Seine by two engines into a large reservoir placed upon the platform at 35 metres from the ground. This reservoir fulfils also the function of supplying water to the engines of the generator house, which consume over 200,000 litres per hour. It can also be utilised in case of fire. Such is the outward appearance of the building which will contain the fifth or electrical group of exhibits, and it is in every way worthy of its name. The electrical exhibits are divided into five classes as follows:—"Production and mechanical utilisation of Electricity," "Electro-chemistry," "Electric Lighting," "Telegraphy and Telephony," and "Various applications of Electricity." Judging by the space allotted, the class of "Telegraphy and Telephony" promises to be very large and complete.

In order to get a useful idea of the topography of the Exhibition, we mounted upon the "moving platform," * which is a new application of electricity as a motive power, and promises to be of great popularity and utility. Some details of this platform cannot fail to interest electrical readers. The "moving platform" and the electric railway are both under the management of M. de Mocomble, and run over exactly the same course, but in opposite directions. Their power is derived from the same sources. The idea of a moving platform is not new. The more the value of time increases in a commercial country the more one is impressed by the considerable loss resulting from the frequent stoppages of our trains and other means of locomotion. A French engineer, M. Hénard, seems to be the first who endeavoured to avoid these stoppages, and he proposed for this purpose a continuous train of wagons moving over ordinary rails. The proposition was made in 1889 for the last Paris Exhibition. The platform was to move at the rate of 5 kilometres per hour, with a stop of 15 seconds per minute to allow passengers to embark or disembark, the speed being thus reduced to 4 kilometres per hour. Nothing came of this proposition until the Chicago Exhibition of 1893, where a travelling platform was used to carry passengers to the lakes, and the original idea was improved upon by two American engineers, Messrs. Gilsbee and Schmidt. In order to increase the speed of 4 kilometres per hour, they first suppressed the stoppage of 15 seconds per minute, which simply increased the wear and tear of the material without any corresponding advantage, the time being quite insufficient to admit of comfortable mounting and dismounting. A man walking very easily covers 5 kilometres per hour, and nothing is easier for him than to mount upon a platform moving at the same pace. By the same means, if he continue to walk upon the first platform at the same speed, it will be very easy to mount a second platform moving at 10 kilometres per hour.

There is nothing to prevent a continuance to a third or even fourth platform, in each case increasing the speed by 5 kilometres per hour. Experiments were carried out by Gilsbee and Schmidt on a line in Jackson Park, Chicago. They used two platforms, one moving at 4 kilometres per hour, and the second at 8 km. and carried over 10,000 persons of both sexes without accident. The more rapid platform was provided with seats, and at certain points posts were provided for the assistance of those persons who required some support in passing from one platform to the other. The difference in level of the two platforms was only 5 centimetres, and was filled with rubber to prevent the foot being caught. In order that the platform should be able to negotiate the corners, the surface was not continuous, but composed of sections of about 10 feet in length, so coupled as to allow of turning in a fairly large arc. The means of obtaining the two speeds was as follows:—Hénard's platform was a veritable train running on an ordinary rail. The platform of Gilsbee and Schmidt was furnished with a continuous rail which passed over fixed wheels. By this system it was very easy to arrange for two speeds. The revolving axis is furnished with wheels of different diameter, the larger of which carry the more rapid platform, the smaller carrying the slower platform. The Berlin Exhibition of 1896 had a rolling platform, but it was left to the present Exhibition of Paris to instal the largest and longest in the world.

The platform is fixed on a viaduct of 7 metres in height built of wood, and travels over a distance of 3,500 metres, passing by the following streets: the Esplanade des Invalides, along the Rue Fabert, the Quai d'Orsay, past the beautiful street of Foreign Pavilions, across the Champ de Mars, through the whole length of the Avenue de la Bourdonnais, then leaving the Exhibition enclosure it passes down the Avenue de Lamotte Picquet, and enters the enclosure again on the Esplanade des Invalides. There are 12 stations by which passengers can mount and dismount, all, of course, situated in the Exhibition grounds, and the fare is 50 centimes. The viaduct in the present Exhibition has a fixed path about 3 feet in width, another path moving at 4 kilometres per hour of about the same width, and a third path about 7 to 8 feet in width moving at 8 kilometres per hour. No seats are provided. The whole distance occupies 53 minutes on the slower platform, and 26 minutes on the faster one. Yesterday (Sunday) the platform was crowded for its whole length throughout the day; it should be a paying concern. The force is furnished by the Western Railway Company's dynamos, and is transformed into a continuous current by the Westinghouse system and carried to the platform by nine cables. The mobile platform should have a great future before it, if the popularity of the present erection can be taken as a criterion of its value. Leaving the platform, we visited the electric railway, which we will describe in our next letter.

(To be continued.)

* Some notes on this movable platform appeared in the Review for February 10th, 1899, page 197. We read in the *Daily Telegraph* that on Saturday last great disappointment was experienced by Exhibition visitors owing to the temporary breakdown of the movable platform. This was caused by the ignorance or carelessness of a carpenter, who damaged the electric cable near the Alma Bridge, and the current from the works at Asnières was accordingly interrupted. Owing thus to a cause which might easily have been obviated if the carpenter had been careful, thousands of people were compelled to traverse the Great Fair on foot, and this was no easy task on a day of exceptional heat, for since Friday last the weather has been worthy of midsummer.

ELECTRIC DRIVING FOR HEAVY MACHINE TOOLS.

[COMMUNICATED.]

In the *Engineer* of March 23rd there appears an article under the above heading, which deals with the conversion to electrical driving of some of the tools in one of the large Sheffield steel works.

When electrical driving was decided on, a number of readings were taken which gave the power consumed by the various tools, and which enabled the engineers to decide as to the best sizes of motor to adopt throughout the shops.

The article commences by saying that for readings of this description dead-beat ammeters are not suitable—at all events, not as suitable as recording ammeters.

The present writer is rather inclined to query this, and from his experience he has found that a good commercial dead-beat ammeter is, on the whole, more suitable for taking these test readings than a recording ammeter.

Recording ammeters are very liable, after they have been in use for some time in dirty shops, to give readings which are not accurate—due to the pen sticking, and other reasons.

The person taking these tests is liable, after the novelty of the work has worn off, to start the recording ammeter and to leave it, and consequently any sticking is not always observed.

In making tests of this description the two readings which are required for each tool are the maximum power taken and the average power taken, and a dead-beat ammeter and an intelligent observer will get as close results as are required.

These readings are taken from all the tools and shafts

embodied in his patent, and if so embodied, the patent is

ground to the higher palace behind. A large hemispherical

likely to be motor driven, and from them certain standard sizes of motors are decided on, for use throughout the shops.

The importance of keeping down the number of different sizes of motors cannot be too strongly urged, even at the expense of putting in somewhat larger motors for some of the tools than is actually necessary.

The article goes on to say that during tests of this description the volts cannot be relied on as keeping constant, due to the following reasons :—

(*a*) Speed variations in the generator.

(*b*) Variations of call for current in the machine itself.

(*c*) Variations of call for current in other machines on the same circuit.

Surely it appears that this result is most unusual in anything like a modern generating set. However much the motor load may vary, the pressure should never rise or fall more than 5 per cent. from the normal, and this result is easily obtained with either shunt or compound wound generators direct coupled to any of the better governing high-speed engines.

At all events the slight variation in pressure need not be taken into consideration in test readings of this description.

The article in question points out that enclosed type motors are used. If these motors are *totally enclosed*, namely, will stand a fire hose being turned on them for five minutes, satisfactory results may be expected, but one sees now-a-days so many so-called enclosed motors being put in, motors which are only partially enclosed, that one is rather liable to be frightened at the very mention of enclosed motors for work of this description.

There appears to be no question that for dusty work the choice lies between a totally enclosed motor and an open type motor.

In the former dust cannot get in; in the latter, if it does collect, it can be easily removed. The writer inclines towards an ordinary open type motor, and if mechanical protection is advisable, to fit a wooden box over it, which can be bodily lifted off for inspection or cleaning.

Mention is made of the fact that planing machines are difficult to drive with independent motors, and the author goes on to say that it would appear best to drive not less than three off a separately driven shaft. This is, no doubt, an excellent way of driving planing machines, if they can be arranged in a line, but floor space and the most favourable position for the tool in a shop will not often allow this.

In addition, it must be borne in mind that planing machines, almost more than any other tools, are out of work for a large percentage of their time, in having new work fixed, &c., and consequently there are advantages in being able to totally shut down the power by having a motor to each planer.

Each case must, however, be judged on its own merits, though in all probability there are more cases where a motor to each planer will introduce savings, than there are cases where the planers can be grouped together, to the best advantage.

Mention is made of the fact that difficulty was experienced in running motors in parallel for driving the planing machine shaft.

It is not easy to understand where the difficulty came in, and assuming the motors were of suitable design, the problem is a simple one.

It is not very frequently that motors are required to run in parallel like this, but even in the early days of motor work, the writer remembers seeing Messrs. Crompton at Chelmsford, using motors in parallel for driving a shaft for testing dynamos, when the steam engine available for dynamo testing was not large enough for the work.

Under these conditions the load on the shaft varied considerably from time to time, yet it was taken up equally between the motors without difficulty. It can therefore be taken that if motors are required to run in parallel, they can readily be made to do so.

In conclusion, it is rather interesting to note that the maximum power consumed in the large planers (of which ampere curves are given) is at the end of the cutting stroke, whilst in most of the smaller size planers which the writer has come across the maximum power is required at the end of the return stroke.

This, no doubt, is due to the slower return speed of the planers mentioned, as compared with the cutting speed. In most small planers the return speed is, of course, considerably increased, whilst keeping the cutting speed somewhere about the same.

CURRENT SPECIFICATIONS.

VI.—SOUTHAMPTON LIGHTING AND POWER PLANT EXTENSIONS.

SUMMARY.

Plant Required.—One 300-KW. steam dynamos, the dynamo having a double-wound armature.

Speed Specified.—Not to exceed 180 revolutions per minute.

Type of Plant.—Vertical compound engine, with multipolar dynamo, having two armature windings and two commutators.

Output of Engine.—450 B.H.P. when working non-condensing with a steam pressure of 140 lbs. per square inch at engine stop valve. To be able to work continuously for two hours at 25 per cent. overload, and for a few seconds at 50 per cent. overload, without injury.

Output of Dynamo.—See below.

Specified Date of Completion.—Four months from date of order.

Penalty for Late Delivery.—One-half of 1 per cent. of value of set per week or part of week.

Stipulations as to Wages Paid to Workmen.—Unsatisfactory. See below.

Stipulations as to Removal of Foreman.—Satisfactory.

Arbitration.—None permitted.

This specification has been prepared by Messrs. Kincaid, Waller & Manville, the consulting engineers to the Corporation. So far as the technical portion of the specification is concerned, there is little to criticise and much to commend. The requirements are clearly set out, the conditions under which the tests of the plant before acceptance distinctly given, and while the combined efficiency of the plant must not be less than 84 per cent., the steam consumption per E.H.P.-hour which the contractor will be prepared to guarantee at full load under bonus and penalty is to be stated in the tender. A margin of 2½ per cent. will be allowed on this guaranteed figure before penalty is enforced, and the sum of £20 for each 1 per cent. of the guaranteed figure will be paid as bonus or deducted as penalty for variations in the actual from the guaranteed figures. Should the steam consumption be much below the guarantee, the engineers reserve to themselves the right to reject the plant.

The dynamo is specified to have two armature windings and two commutators, switch gear being mounted on the machine to permit of these windings being connected either in series for traction work, or in parallel when used for lighting.

When used as a shunt-wound dynamo for lighting, each armature is to be capable of developing 150 KW. at 210 volts, shunt resistances being provided to permit of variation of terminal voltage at constant speed between 205 and 220 volts. It is intended that the two armature windings shall be connected in parallel with each other.

When the dynamo is used for traction work the armature windings are connected in series with each other, and as a compound-wound machine it must be capable of developing, as normal load, 300 KW. at 550 volts, the terminal voltage falling at no load to 500 volts. The steam dynamo must be able to work continuously at 25 per cent. overload for two hours, and without injury at 50 per cent. overload for a few seconds.

If desired, an alternative offer may be made for a dynamo not only able of meeting all the above conditions, but also of giving as a shunt-wound machine at normal speed, with both armature circuits in series, 400 amperes at 460 to 600 volts for all charging purposes.

It is specified that a sum of £350 be allocated in the tendered sum, to be expended at the engineer's discretion in providing additional panels to the existing switchboard, and

offers are invited for the acceptance, as part of the purchase price of a 100-KW. Westinghouse engine and belt-driven Westinghouse traction dynamo at present used as temporary plant.

Referring to the general conditions, the two principal points to which exception should be taken by tenderers, are the absence of any provision for arbitration, and the stipulations as to date of completion and penalties to be enforced if the specified time date is exceeded.

The clause in the general conditions dealing with the first point, reads as follows :—

All works in connection with this contract *must be carried out to the entire satisfaction and under the superintendence of the engineers,* whose directions on all points in connection therewith shall be complied with, whether given personally or by their representative. *And if at any time during the progress of the works any dispute shall arise as to the true intent and meaning of the drawings and specification, such dispute shall be decided solely by the engineers, whose decision shall be final and binding on all parties.*

We have here the placing of the engineer in the anomalous positions of *counsel* and *judge*, he first prepares his own case, and then is appointed under the terms of the contract to give a decision from which the manufacturer has no right of appeal.

We strongly advise that tenderers stipulate that either the following standard clause, or one embodying the same principle be inserted in the final contract.

In case any dispute or difference shall arise between the purchaser, or his engineer on his behalf, and the contractor, either during the progress of the works or after the determination, abandonment, or breach of the contract, as to the construction of the contract, or as to the reasonableness of any extra charge, or as to the withholding by the engineer of any certificate to which the contractor may claim to be entitled, then either party may, within 72 hours, but not later, give to the other notice in writing of the existence of such dispute or difference, and such dispute or difference may be referred to arbitration, which arbitration shall be deemed to be a submission to arbitration, within the meaning of the Arbitration Act, 1889.

The second point is thus referred to :—

The works *shall be commenced within one week of the signing of the contract, and shall be finished and handed over to the Corporation in complete working order to the satisfaction of the engineers within four months after the date of such contract,* or within *any earlier period than four months* after the date of the contract that may be agreed upon at the time of signing of the contract, failing which the contractor shall pay to the Corporation *one-half per cent.* of the gross value of the contract *per week for each week* or *part of a week* by which the date is exceeded, such one-half per cent. to be paid to the Corporation as and for liquidated and ascertained damages, provided always that if by reason of extra works, alterations in, or deviations from, the specification directed in writing by the engineers, or by reason of general or local strikes or combination of workmen, or in consequence of any *bonâ fide* accident to machinery in the manufacturer's premises causing a delay in the supply of plant or materials to the contractor, the engineers may grant from time to time, in writing, such extensions of time for completion as shall seem reasonable to them.

The period of four months for the completion of erection of a 300-KW. steam dynamo of this character, when the dynamos are of such a special type, is altogether too short. Unless any firm has such a set in course of construction and approaching completion, it will be practically impossible to obtain early enough delivery of raw materials to permit of this date being adhered to. Judging from the times guaranteed in recent contracts which have come under our notice, *six* to *eight* months is the very shortest period which is likely to elapse before the set is ready for use. If the penalty is to be enforced, there is no course open to tenderers but to protect themselves by adding a suitable percentage sum to the sum they wish to actually receive for the set before making up their tendered price.

Although there is nothing of an unfair character about it, tenderers should note the clause relating to the wages to be paid to workmen in their employ :—

The contractor shall pay the men employed by him not less than the minimum local standard rate of wages, *as settled from time to time between the Masters' Association and Trades Unions respectively, in each branch of the trade at the date of this contract.*

The clause referring to possible modifications made in the plant to be supplied during its construction is of a rather one-sided character, and if carried out strictly would probably act to the detriment of the purchaser. It reads :—

Should the contractor, during the progress of the works, desire to make any alterations, additions, or modifications, he must first obtain the approval, in writing, of the engineers, and such alterations, additions, or modifications so approved shall in no way invalidate the contract, and no extra payment shall be allowed in respect thereto. The engineers shall be at liberty to make, during the progress of the works, any alterations, additions, or modifications they may consider expedient.

Any such alterations shall in no way invalidate the contract, but the value of the same shall be ascertained, and either added to or deducted from the contract by the engineers.

Whatever improvements the contractor may, during the progress of his work, devise, if he is debarred from being paid any extra sum for their adoption, he is not likely to suggest them, whatever may be their ultimate benefit to the purchaser. Surely there can be no objection to allowing the same latitude in regard to improvements suggested by the contractor as well as by the engineer. In all probability neither has a monopoly of genius, and there are few, if any, electrical plants either in use or under construction which are not capable of improvement.

The clause in the general conditions entitled "Sub-Letting of Contract" is not likely, in the hands of the well-known firm of consultants who drew up this specification, to cause trouble, but as worded, it might involve the contractor in much unanticipated expense. Power is reserved to the engineer to refuse apparently without giving a reason assent to materials being obtained from certain firms. To purchase them from approved firms may mean extra outlay for the return of which to the contractor no provision is made, while for any breach of this condition a heavy fine is imposed. We think that while admitting the general principle of purchase of materials from approved manufacturers, the clause could be so worded that abuse of its provisions would be rendered impossible. At present the clause reads :—

The contractor shall not assign his contract, or any part thereof, without the consent in writing of the engineers, nor may he underlet the same, or any part thereof, nor make any sub-contract with any person or persons for the execution of any portion of the work unless such contract shall be approved in writing by the engineers. It is not intended by this clause that the contractor shall necessarily be the manufacturer of all appliances and materials which he may employ, but that the names of the makers of all such materials or appliances shall be submitted to the engineers for approval; and no sub-contractor shall be allowed to do work within the buildings of the Corporation except by the special instructions of the engineers. For any breach of this clause a sum of 5 per cent. on the amount of the work so sub-let may be deducted from any sum due, or to accrue, in respect of this contract.

THE TELEGRAPHONE.

THE telegraphone is the name of a recently-invented apparatus of particular interest, its principle being based on physical facts hitherto not employed, as far as we are aware.

The inventor is Mr. V. Poulsen, C.E., of Copenhagen, who has now made the technical public acquainted with his general idea, and, besides this, has demonstrated its mode of action in a most clear and convincing manner.

The telegraphone claims to be nothing less than a special kind of phonograph to be acted upon from a distance through the agency of electricity. It is, indeed, an electro-magnetic phonograph to be used in combination with microphones and telephones, the sounds from a transmitter being telephoned to the telegraphone, then fixed in invisible writing by this wonderful apparatus, whence it again at any time can be reproduced in a telephonic receiver.

The principal difference between the ordinary phonograph and the telegraphone consists in the fact, that in the latter instrument the "phonetic writing" of the sound waves is not performed mechanically but only magnetically by means of an electro-magnet, the moving basis being made of steel or nickel instead of wax or similar substance. To explain the action: Suppose the electro-magnet to be magnetised by telephone currents, while say a steel band passes just close along its poles, the surface of the steel will be permanently magnetised more or less strongly, corresponding to the varying magnetism of the electro-magnet, viz., to the telephonic currents. On reversing the action by again letting the steel band, "prepared" as above—in proper direction—be moved quickly in front of the poles of the same or another electro-magnet, whose windings now are to be connected to a telephone, varying currents due to the different magnetisation of the steel band are induced in the

This, no doubt, is due to the slower return speed of the planers mentioned, as compared with the cutting speed. In

tendered sum, to be expended at the engineer's discretion in providing additional panels to the existing switchboard, and

said windings, causing the telephone to repeat exactly the sounds once fixed upon the telegraphone as often as is desired.

As has been proved by numerous trials the telegraphone gives off the impressed speech quite as genuine and free from secondary sounds as, for instance, the telephone, and in comparison with the phonograph, it has the advantage that the phonetic writing, although not to be wiped out in a mechanical way, may be very easily obliterated by sliding a rather strong magnet (or magnetised electro-magnet) along the surface of the steel basis; indeed, whenever this is done, every trace of the writing is done away with and the instrument is once more fit for receiving new impressions.

As to details, a very small electro-magnet, say some few millimetres long, is sufficient as well for "writing" as for "reading." Instead of a steel band, it has in some instances been found more practical to use a pianoforte wire wound screw-threadlike in grooves upon a horizontal drum rotated, for instance, by a small electro-motor, while the "writing" or "reading" electro-magnet is shifted along a metallic rod parallel to the axis of the apparatus by means of the screw-laid windings themselves. When all the wire has been "used," the electro-magnet is automatically detached and quickly brought back to its starting position by a special arrangement. The next construction of this and the other forms of the apparatus we learn are principally due to Mr. P. O. Petersen, C.E., who has invented a method of his own, not yet published, by means of which it is said to be possible to superimpose several "speeches" upon the telegraphone in a manner that will allow each separate "speech" to be "filtered" out of the instrument.

The form of apparatus mentioned with pianoforte wire will, however, only do for, say, a speech lasting a minute. When the telegraphone is to report a long speech, steel bands, preferably some millimetres broad and $\frac{1}{20}$ mm. thick, have been employed with good results. The band is then unwound from one reel on to another, and is "prepared" by the electro-magnet during its motion at any point between the two reels.

In connection with ordinary telephone lines, the telegraphone has been tried in practice as a receiver, and put automatically in action, when the bell is rung, then registering what the sender has to say. The subscriber called for can then at any time (say on returning home), read it off, as will be understood from the above. Another particular application of the instrument is due to its capacity to reproduce the speech to a large number of subscribers at the same time. In this case, the steel band must be a continuous one, arranged and moved, for instance, in the same way as a band saw. All along the band a number of small electro-magnets are fixed, the first one connected to a telephonic transmitter, the others to the different subscribers. When the impressed speech has acted upon all the electro-magnets, it is wiped out by a magnet.

So much about particulars. Curiously enough the inventor has had some trouble in obtaining patents in several countries, the scientific members of some patent commissions denouncing the invention to be a physical impossibility, till convinced by demonstrated facts.

We learn that the telegraphone is to be exhibited this year at Paris, where, no doubt, also some readers of this journal will find an opportunity to listen to the tale of this interesting novelty.

K & G.

Copenhagen, *April*, 1900.

POWER CONSUMPTION AND OPERATIVE COSTS OF AUTOMOBILE DELIVERY WAGONS.*

A Study of the Comparative Costs of Operation and Maintenance of Horse and Electric Delivery Wagons for City Service.

By Prof. GEORGE F. SEVER.

The purpose of this article is to present a brief *résumé* of the data and results obtained in the early part of 1899 while investigating the operative costs of electric and horse delivery service in New York city.

In the paper on "Operating Costs of Horse and Electric Delivery Wagons in New York City," by R. A. Fliess and the writer, presented at the general meeting of the American Institute of Electrical Engineers, at Boston, in June, 1899, a very careful analysis was given of the actual costs of operation of the two methods of service under city conditions. Up to that time there was available little information of an authoritative nature on the cost of horse operation, and therefore this information, obtained from business houses with large delivery services, provided a basis of comparison which is valuable. More recent figures, obtained from other business houses using horse service, corroborate the data on this service, so that we can accept these figures as a recognised standard.

From the data on horse operation, the cost of maintaining such service was found to be as follows:—Total cost of one wagon, one horse, wages and attendance per day equals 364·83 cents, of which 64·61 cents, or 17·7 per cent., is chargeable to the horse, 14·52 cents, or 3·98 per cent., is chargeable to the wagon, and 285·7 cents, or 78·32 per cent. is required for the wages of the driver and his helper.

The total weight to be moved is 2,075 lbs., or, approximately, 1 ton, 500 lbs. of this being considered the weight of the load to be delivered. In this service each wagon covers 21 miles per day, so that the cost per ton-mile, which is the unit of comparison, would be $364{\cdot}83 \div 21 = 17{\cdot}373$ cents.

In the case of a wagon covering twice the distance of the first, *i.e.*, 42 miles per day, there will be needed two horses, and therefore an additional expense for those items, as is shown by the following figures:—Total cost of one wagon, two horses, wages and attendance per day equals 428·54 cents, of which 128·32 cents, or 29·9 per cent. is chargeable to the horse, 14·52 cents, or 3·3 per cent., is chargeable to the wagon, and 285·70 cents, or 66·8 per cent., is chargeable to the wages of the driver and his helper. The cost per ton-mile will be $428{\cdot}54 \div 42 = 10{\cdot}2$ cents in considering the cost per pound of load per mile; under these two conditions we find that, in the first instance, with a total load of 800 lbs. and an average of 500 lbs., this cost is $364{\cdot}83 \div 800 = 0{\cdot}456$ cents per pound and $364{\cdot}83 \div (500 \times 21) = 0{\cdot}0347$ cents per pound per mile.

In the second case, with more load delivered, a longer distance covered, and requiring more equipment, we find the cost per pound with three loads of 800 lbs. delivered $428{\cdot}54 \div 2{,}400 = 0{\cdot}17856$ cents, and the cost per pound per mile with an average load per trip of 500 lbs., $428{\cdot}54 \div (500 \times 42) = 0{\cdot}0204$ cents.

The conclusion is readily deduced that the latter method of operation is the more economical although involving a larger first cost for equipment. In the second case the wagon is used nearly three times as much as in the first and the employés are used to better advantage, thereby tending to more economical operation.

The tests on the electric automobiles were made for the purpose of ascertaining the actual power required to operate them on the various pavements which exist in New York city streets, the vehicles used for this purpose being those which were to be used in delivery service. The opportunity presented itself to test vehicles of different design and widely differing characteristics, so that from the results could be obtained a general and quite accurate figure for the power consumption necessary for this service. From these tests the power required is found to be 120 watt-hours per ton-mile, or 0·156 H.P.-hours per ton mile.

This value for the power consumption has been borne out by subsequent tests, and can be considered a reliable value to use in estimating the average power necessary for operation. It must be remembered, however, that a larger capacity than that which is necessary to provide this 120 watt-hours per ton-mile is imperatively required to start the vehicle or propel it up a grade. The power to give a rapid start may be from four to six times that which is necessary for operation at a constant speed on a level, or that value which represents the average of a run.

The minimum power used in any of the tests made was 81 watt-hours per ton-mile, showing that with careful manipulation and taking advantage of the features of the roadway, the power used may be reduced considerably from the general value of 120 watt-hours per ton-mile.

* New York *Electrical Review*.

additions, or modifications so approved shall in no way invalidate

connected to a telephone, varying currents due to the different magnetisation of the steel band are induced in the

In order to ascertain the difference between the cost of delivery with horse and that with electric vehicles, the following comparison can be made:—An electric wagon, at an average speed of 9 miles per hour, would cover the same distance per day, *i.e.*, 42 miles, as made by the horse wagon in 4·66 hours and the cost for power at 5 cents per kilowatt-hour, with a power consumption of 120 watt-hours per ton mile, would be 71·28 cents. The weight of the wagon complete, with average load of 500 lbs., is 2·263 tons. In this case the cost of power, 71·28 cents, forms 17·6 per cent. of the total operating cost, interest on wagon and stable rent, 47·28 cents, forms 11·7 per cent., and wages for driver and helper, 285·70 cents, form 70·7 per cent., the total cost for operating 42 miles being 404·26 cents. As compared with the cost of horse service, there is seen to be a saving of 428·54 — 404·26 = 24·28 cents per day under the above conditions. The cost per pound of delivery is 0·16844 cents against 0·17816 for the horse, or 0·01012 cents less. The cost per ton mile is 4·25 cents against 10·2 cents for the horse, or a saving of 5·95 cents.

This figure is of importance, for the reason that the ratio of load to be delivered to total weight of wagon is small, and every effort should be made to reduce the weight of the wagon, in order to reduce the total power cost. If the figures are analysed somewhat differently from the method indicated above, leaving out the fixed wages for driver and helper in both cases, it is found that the cost of the horse forms 90 per cent. of the operating costs in that service, while the cost of power in the electric service is only 60 per cent. The actual cost of operation then becomes 142·84 cents per day for horse, and 118·56 cents for electric, showing, as before, 24·28 cents per day saving in the latter, this being a 17 per cent. saving over horse operation. This is unquestionably a more correct method of comparison in the matter of power cost, as the fixed charges are eliminated. At present it is not possible to present any depreciation values, for the reason that the apparatus is too new to afford any. In the electric service these depreciation values should not be large, as the motors and running parts are simple, and require but little attention. The battery possesses the largest depreciation factor, it being possibly 20 per cent.

In comparing the cost per pound of load per mile, it is found that with horse service this is 0·0204 cents, and with electric 0·01923 cents, or a saving of ·0015 cents.

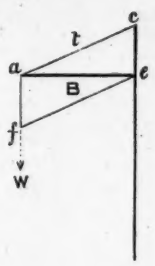
That the differences shown are not larger is due to the fact that in making the comparisons, the lowest average cost for horse service has been taken and the highest cost for electric service has been placed against this. With cheaper power a further reduction can readily be made in the operative costs and a better showing made for the electric service. It can be pointed out that if the schedule speed of the automobiles can be raised, the wagons can cover much more territory per day, and therefore reduce the percentage that the employés wages are of the total. This is a similar condition to that which exists in electric railway operation, and many of the same operative details that now control railway work can be successfully applied to electric delivery service. As has been hinted at previously, the attempt should be made to reduce the weight of the automobile for this service in order that the live load may more readily approach the dead load, thereby decreasing the power cost.

CORRESPONDENCE.

Overhead Construction.

I must thank "J. M. D." for calling attention to my error in the issue of April 6th. The figures of the bracket arm length and pole length in the calculation of pull were, of course, reversed, and the figures should read $\frac{90 \times 5}{20} = 22\frac{1}{2}$ pounds.

But the pull on the pole top is somewhat more complex. Its severity depends on the ratio of the arm length $a\,s$ to the distance $s\,c$ of the point of application of the tie rod. Thus if the bracket arm be 5 feet long, and carry a load of 90 lbs., and the distance $c\,s$ be $2\frac{1}{2}$ feet, will not $a\,s$ represent the pull on the pole, and $a\,s$ the thrust in the bracket arm of 180 lbs. The horizontal component of $a\,c$ will also be 180 lbs. So far as this stress is concerned the pole is exposed to a bending stress about the point s considerably in excess of the general stress in the pole. With long arms as, say, 20 feet, the ratio of $a\,s$ to $s\,c$ will be 8 : 1, unless $s\,c$ is made, say, 5 feet, which is its limit, when the ratio will be 4, and the pull on the pole at c and thrust at s will be 360 lbs. upon this upper part of the pole, due to trolley wire alone; and when the bracket and scroll are taken into account, it is clear that the small upper section of the pole will be exposed to a severe bending stress from which the pole as a whole is free. It is always in the upper



part of poles that weakness develops, and it is rather this than the general over-balancing load that is to be considered. A pole loaded by a cantilever is likely to show a severe bend at the point of application of the trust of the arm s.

The net pull on the whole pole may be thus worked out:—Assume that $s\,c$ is $2\frac{1}{2}$ feet, and that the point s is 20 feet above the floor line. The arm $a\,s$ is 5 feet. Then the pull at c is $180 \times 22\frac{1}{2} = 4{,}050$ foot-pounds, and the thrust at s is $180 \times 20 = 3{,}600$ foot-pounds. The difference is 450 foot-pounds. Then $450 \div 22\frac{1}{2} = 20$ lbs., and this is the equivalent pull at the point of application of the tie rod, $22\frac{1}{2}$ feet high, upon the pole as a whole referred to its fulcrum at the ground level, and, as it seems to the writer, not 35 lbs., as found by "J. M. D."

Side bracket arms thus require to be dealt with, first, in reference to their effect on the pole upper section; and, secondly, in regard to their effect on the pole as a whole. In this second case the ground is the fulcrum; in the former case the fulcrum is at the bracket arm clamp. It is evident that the above method is correct, for no matter what ratio of $a\,s$ to $s\,c$ be fixed upon, the difference in the foot-pounds of thrust and pull will always be 450, showing that whereas the local stress in the pole top can be varied according to the position chosen for the tie rod, the general stress is unaltered. This holds good when $s\,c$ becomes excessively small, which is the case when no tie rod is employed, for the moment becomes then simply the product of 90 lbs. × 5 feet, or, again, 450 foot-pounds.

The Writer of the Article.

Economy of Mechanical Draught.

I do not consider that the importance of this question has had anything like proper recognition; we have discussed it from both sides, and got back to where we started, simply because we have failed to get hold of any facts.

That was my object in meddling with the discussion. I have looked and read in all directions, and found everyone who approached the point, as soon as he got near, sheered off and left it untouched.

For instance, the last and most important book I have connected with the use of steam, published in 1898, says, speaking on the subject of a system of forced draught: "An increase in evaporation of from 40 per cent. to 50 per cent. is said to result." More is said of a similar kind; but what is the value of such a statement as that? I call it *mere gossip*.

Fortunately, since I wrote you last, I am in receipt of the last Vol. cxxxix. of the Civil Engineers, and that does give some figures which seem to warrant me in writing you again. Let us examine them.

* New York *Electrical Review*.

value of 120 watt-hours per ton-mile.

The paper is as fairly written as we can expect from one trying to prove that in cremating muck he has found a substitute for coal; it is entitled, "Combined Refuse Destructors and Power Plants."

In such a case as a destructor I would expect to find if anywhere forced draught justified, and yet in the course of the discussion Mr. E. J. Lovegrove, who evidently has thought and knows what he is talking about, says: "With regard to the nuisance, greater trouble was experienced from forced draught than with natural draught; this would also prolong the life of the furnaces and reduce the expenditure for repairs to a minimum."

But let us examine as shortly as possible what is to be learnt in illustration in the paper itself.

There are two batteries of three water-tube boilers, each having two refuse furnaces. The gases after passing through the tubes go to the economiser and then to the shaft; each furnace is provided with both steam and forced air draught, the author finding the latter preferable.

The forced air is provided by three fans, each designed to give 8,000 cubic feet of air per minute, and driven by a shunt-wound electric motor at a speed of 650 revolutions per minute, and, in reply to questions, we learn in the discussion that "the delivery of the fans was that guaranteed by the makers;" but just note the following, which is an illustration of a point I raised in my letter on the testing of fans.

"The air pressure in the discharge duct at the fans is 3 inches head of water, while that in the ashpits is only about 1 inch." Later in a table we see that the air pressure was really 0·90 inch; then why use a fan? Surely the chimney they have would give this, and if properly managed a suction draught is just as efficient as a forced one.

But look at this point: the fans are running at a speed which gives 3 inches at their outlet and only 0·90 in the ashpits—that is the pseudo W.G. to which I alluded in my letter on fans.

Mr. Blair in the discussion calls attention to it, and says:—"Such a marked difference in a comparatively short distance must be accounted for, he thought, by friction, possibly by reduced passages," and the author, in his reply, agrees with this, saying: "The difference was accounted for by the enlarged air ducts, as the air approached the furnace, and by leaks in ashpit doors, &c."

They are both mistaken, and evidently unaware of the fact that the fans are too small for the volumes they are asking them to supply; if the fans had been large enough, they would have had the same air, and the fans would have worked at 1·00 inch instead of 3 inches. Look at the result. I am sorry the diameter of the fans is not given, because then we could have ascertained their manometric efficiency, which, under the conditions, I think must be very low.

We have Mr. Brown properly saying: "The energy absorbed by the electric fans certainly seems to be excessive, viz., about *fourteen* per cent. of that generated by the refuse," that does not seem to be a cost to be treated as the pitman did his baccy.

I look at it in another way, thus:—

The fans are said to absorb 4 units per ton of muck dealt with. Total refuse destroyed year ending June, 1898, 25,404 tons, and this equals for fans, in the course of a year, 101,616 units; these they sell for power purposes at 2d. per unit, which gives the cost of their forced draught, £846 per annum. I could compare it in various other ways, but let one suffice. In the discussion Mr. Liversedge said: "If therefore those two figures were correct, the author used something like 72 lbs. of steam per unit;" and as I have shown his fans require 101,616 units per annum, it makes a consumption of 7,316,352 lbs. of steam; now assume an engine takes 20 lbs. of steam per hour, and we get 365,817 H.P.-hours, at my price of 1d. per hour, gives the sum of £1,525 per annum as the cost of his fans, you demur to the 1d. per hour, but I was really too modest. Look at the excellent work of that careful experimenter, Prof. Unwin, on "The Development and Transmission of Power," p. 59, you will see he says a 10-H.P. engine costs 2·84d., and a 50-H.P. engine 1·51d. per effective H.P.-hour, that, of course, includes interest at 5 per cent., maintenance and depreciation at 7½ per cent., both very reasonable, so that I am in good company when I say one penny.

I should have liked to glance for a short time at the question of steam-jet draught, but I doubt that your space and my time on the present occasion will not permit it; I trust that what I have said will have the effect of inducing those who are using mechanical draught to look carefully into their position, and the necessity for it; but what we want, what I cannot get, although what I mean to have if I live long enough, is a statement of unimpeachable *facts*.

A. L. Steavenson.

Durham, *April 23rd*, 1900.

P.S.—The 3 inches W.G. is required to force the volume through the fans, which are themselves an obstruction.

Fuses.

May I call attention to the apparent general misuse of fuses, and express a hope that engineers will abandon their employment in circuits where they are useless.

A fuse is a more or less primitive device for interrupting a circuit when it becomes overloaded, its only perfect attribute being the complete and glorious uncertainty with which it acts.

Omitting the consideration of small fuses of the genus "house wiring," and dealing only with those used in generating stations, we find that they are employed in two different situations, viz., in feeding and generating circuits.

Taking the case of fuses in generating circuits, we know that in some circumstances they are worse than useless. Suppose that a breakdown occurs to one of three fully-loaded dynamos of equal power working in parallel; then the external load plus the load necessary to burn down the fuse of the faulty machine will be more than sufficient to blow both of the healthy machines' fuses, with the result that the faulty machine's fuse will remain intact and supply will be interrupted. Of course, if a larger number of machines are running, the fuse of the faulty machine must ultimately blow, but the method of cutting off the machine is certainly faulty. Even if the lights do not blink badly it seems utterly wrong to throw the heavy load necessary to burn down a fuse, on the plant, just at the moment when more sources of energy are required for the external load alone. As an experiment in electro-metallurgy it may be interesting, but it is distinctly wasteful to employ 100 KW. or so to open a dynamo circuit. It is somewhat like a hungry man taking a hatchet to cut bread and butter, and exerting himself so vigorously that he is in a fainting condition before he has hewn out the first slice. It is, of course, necessary to cut out a faulty machine directly it begins to take current from the bus bars, but the fuse is too crude and takes too much current for the tardy service it renders. Considering the effect on the dynamos of a short on the feeders, we see that this amounts really to a sudden and heavy addition to the load and that it will be useless to *cut off* machines at the moment when additional ones are required. Fuses then are inefficient devices for dynamos, both for feeder shorts and dynamo shorts; dynamos only requiring to be cut out when they take current from the bus bars, the switching out taking place before the return current has exceeded a few amperes.

Some protective device seems necessary in feeding circuits, though in lighting systems it generally conduces to continuity of supply, to do away with them, and to agree to burn out any shorts that may occur. Short circuits of low resistance, lasting any length of time, are presumably rare, the usual fault being a dead short for a second or two, followed by an arc of comparatively high resistance, which gradually burns itself out. The protective device must, therefore, act quickly, and a heavy fuse is of little good where rapidity of action is required. Automatic circuit breakers are to be preferred, and their general adoption in traction work, where shorts are frequent and severe, demonstrates their superiority.

Fuses should therefore not be used in dynamo circuits, and they should be omitted in feeder circuits, or automatic circuit breakers should be used instead.

Dynamo circuits should be provided with zero or non-return current cut-outs; preferably the latter.

That fuses are really as bad as they appear to be seems borne out by actual practice, and it seems a pity for us to keep on putting them on switchboards when the actual users

either replace the tin strips by huge slabs of copper (tinned or nickel plated to make them look safe), or else pile on the tin strips so that no current the station could produce would blow them. Fuses cost money—some duplex abominations cannot be very much less expensive than automatic circuit breakers—are mere wasters of a little energy, are only specified because they are fashionable, and it is high time that in many cases they were discarded.

Ipse Dixit.

Patent Office Reforms.

In your notice on page 641 of your last issue you say there are many anomalies in the existing law which you would like to see removed. Can you conceive anything more unjust than taking fees from an applicant who deposits a specification containing the following claims :—

1. The idea is absolutely my own.
2. That it will clean out any wooden pipe, no matter how badly corroded.
3. And make it equal to new.

Arthur Clarke.

London, *April 21st*, 1900.

Re Works Dispute.

Noticing an argument in your current issue on the above, we beg to say that we have had a little dispute with a portion of our winders, who, despite the fact that they were being paid 9½d. an hour, which is at least 15 per cent. higher than the standard rate in the country, thought it advisable, seeing that we were busy, to make still better terms for themselves.

We have, we are thankful to say, got rid of some of these greedy gentlemen, and are pleased to say, that though our wages have been reduced some 10 per cent. since their departure, our output has gone up in the same proportion.

D. Bruce Peebles & Co.
A. C. Peebles.

Edinburgh, *April 23rd*, 1900.

"On the Controversy Concerning Volta's Contact Force."

The late Dr. John Hopkinson and another somewhere recorded experiments relating to electrolytic hydrogen polarisation, and showed how much hydrogen was necessary to polarise a given surface, and, if I remember rightly, a comparison was made as to the calculation of the sizes of atoms, and the distance of the centres of the hydrogen atoms apart on the polarised plate, calculated from the weight of hydrogen, which was exceedingly small. Now Dr. Lodge appears to be striving to make clear "contact force" by atoms approaching each other, and as *I* would understand and explain, attriting each other and rubbing off some of their energy, so that two or more atoms by their mutual motion and grinding or squirting of themselves, and, or, of the ether about them, somehow set up or detach a bit from themselves, or form another system of motion of something material, which appears as a surplus or new system of motion tending to find its level or redistribute itself to equilibrium. Then Nature is considerably in equilibrium until two or more systems of motion of such an order approach each other that their mutual motion results in the setting up of a surplus of something—which undoubtedly may be of a positive or negative order relative to what is outside, as exemplified in thermo-chemistry—aggregation or disaggregation, or a matter of surface change, to be afterwards referred to.

But it is not usual to suppose these atoms as systems of motion (and in the present "controversy," the technical overrides the philosophical) mutually accelerating, slowing-down, or eddying each other, in a Pearsonian or squirting manner, and setting up in themselves and what surrounds a different order of things—and this brings me to the older notions of the solid-atom-held-together-with-the-bed-spring-things.

We must either accept the notion of the constant spewing out of energy from or by atoms, so-called, or deal with them as concrete or fixed bodies having some sort of a fixed surface. Now, surface is what I would speak of in explaining contact force. (These ideas and the terms expressing them will have to be swept away when we become civilised—*not* in the *m i c e* acceptation). Of course, force is one, whether "contact" (barbarous expression), "force," or otherwise. For the time being we will speak of "charges of electricity." The idea of time-soaking in, and time-running out, are expressions by no means unintelligible, whether the charge soak into an atom or cell maze or the earth. Well, if one particle of matter meet, impinge, fall into or coalesce (it will take a certain time for the smallest atom to thoroughly mix or arrive at an equilibrium with another, and the outside world will feel every movement more or less) with another particle of matter, then we shall have one of three results; the resultant *surface* of the resultant matter will decrease and be less, or it will increase and be more, or it will be the same. The last of these will mean that whatever wonderful and rapid change of surface may take place during that short time when one atom mixes or meets with another, no energy will leave, or appear to have left, the system. The first will mean that energy will be given, or capable of being given, out; the second, that energy will be absorbed, or capable of being absorbed, energy in this case being the stuff on the surface. But this, then, is all a matter of whether the mutual action of ponderable matter upon ponderable matter results in a change of surface, because if, for argument, we discuss electricity as a charge of something upon a surface, then the density of that charge must be changed by a change of surface, and a change of density, we understand, means a change of potential. The phenomena of heat and other things, I doubt not, has something to do with this atomic rushing in and out of ether or some form of matter. For those of more philosophical turn, the doctrine of matter on the everlasting move in and outside of atoms—of course, there is no such thing as an atom, as we try to picture it, and nothing *negative* in nature—is much more satisfying; but atoms and surface change may explain the contact-eating-vinegar-with-a-fork conundrum. There is a much bigger question locked up with it, however, which surface change will not explain, and that is gravitation, but which is wonderfully easier explainable, with a moving world inside as well as outside of atoms, as opposed to the hard, dead sorts held together with "bed springs."

The laws of motion need revising badly, and our brains want clearing of those chains—the Euclidian boxes of tricks—the little models of perfect doll-houses built up of things which are, and which are not, and which are both at the same time.

What has been pointed out by at least one sane man I know (and he most certainly is thought to be very mad by some), and what is well worth remembering in matters of this kind, and particularly in matters such as fixing units for electricity and the like, is that we have nothing in nature corresponding with our ideas of a line, circle, perfect curve, plane surface, and the like, and never shall have as long as matter *lives*. We are in a live body, and think it dead! But there is no neuter in nature—all lives.

James C. Richardson.

London, *April 19th*, 1900.

Test of a Ventilating Fan.

Referring to the letter of your correspondent "Centrifugal" on this subject, and your comments in your issue of the 20th inst. As the authority for the figures you were good enough to publish, I may possibly be permitted to furnish my little quota in the attempt to reconcile theory with the observed facts.

The fan tested has blades of the screw type, each of which may be considered as a plane revolving in the atmosphere, and inclined to the plane of revolution. Each plane (or blade) as it revolves cuts off a slice of fixed volume or mass of air and passes it forward from atmospheric pressure to atmospheric pressure. There is no cylinder or other confined space to force it through. The force exerted by the blades in passing forward the air is therefore, not that due to the absolute forcing forward of the air, as if this were done at right angles to the blades, as would be the case if the blades were pistons forcing the air through cylinders. The force exerted upon or by the blades would be about proportional to the sine of the angle formed by the blade, and the plane of revolution—modified by centrifugal action, the curve of the

blade both in radial and cross-section, its depth, and the form of fan centre.

The volume of air moved would also vary in the same proportion, but would be further modified outside certain limits, as, if the angle were too slight, the volume would be very small, and if too great the air would be baffled about without being passed through the fan.

As the angles of the blades of the fan tested were about 30°, of which the sine equals ½, this theory agrees with the tests, which I can assure you were taken in a manner precluding any mistakes such as have been suggested; besides which I have taken thousands of tests of similar types of fans, all of which agree approximately with the tests published and theory now stated.

If not taking up too much of your valuable space I should be glad to make some remarks, *re* "Centrifugal's" observations on the question of cubic feet per horse-power. This of course is only correct as a means of comparison where the conditions as to pressure are exactly equal, and as an example of how great the difference in volume per horse-power per minute may be, I may cite a recent test of a similar fan, 48 inches diameter working in a testing chamber 6 feet square extended 6 feet on each side of the fan, and fitted with doors by which the area and pressure on each side could be modified. With the doors full open on each side the volume passed at 520 revolutions was 50,000 cubic feet per minute, and the power consumed 2½ H.P., the feed area being 36 square feet, the average velocity 1,400 feet per minute, and the water gauge about ⅛ inch. When the doors were closed to give an area of 12 square feet only (about equal to that of the fan), the volume was reduced to 31,000 cubic feet, the water gauge being ½ inch, and the power required 4·2 B H.P. By still further reducing the inlet and outlet areas to 9 square feet each, the volume became 25,000 cubic feet, the water gauge ⅝ inch, and the power 5 B.H.P.

Other tests were made in which the feed area was restricted while the discharge area was left free and *vice versâ*. In all cases it was found that about 50 per cent. more air was moved for the same power when the discharge side was free.

This is no doubt true of all fans, that there is more friction when forcing than when exhausting through pipes of equal length and diameter.

For the Sun Fan Company, Limited,
Wm. Tattersall,
Managing Director.

Bradford, *April 23rd*, 1900.

[We must express disagreement with our correspondent's views as regards the force required to propel the air. It does not matter in the least how the force is applied—to raise a given mass of air per minute to a given velocity calls for a fixed minimum power, irrespective of all other considerations.—Eds. Elec. Rev.]

Patent Law Reform.

In your issue of the 6th inst. Mr. Claude W. Hill suggests a system of examining patents for novelty, to which there appears to me to be, on public grounds, serious objection.

It is too readily assumed by most people who discuss this question that the Patent Law exists for the benefit of inventors. I think it would be a much more correct way of stating the proposition, to say that the Patent Law is intended to encourage *bonâ fide* inventors for the benefit of the public. The Government grants a monopoly to an inventor for a certain number of years, on condition that he afterwards presents his invention to the public for the benefit of the manufacturers and consumers for all time. This protection, of course, can only be given to inventions that are new. The class of commercial patents, wanting in novelty, which you mention in your leading article of last week, ought not to receive patent protection, or at least only from a Government which believes in the encouragement of comatose industries by bounties. The granting of a bounty to revivify an extinct manufacture would be much preferable to granting a patent for a *bogus* invention; but the bounty system is opposed to the commercial policy of this country.

The objection to the advisory system of examination suggested by Mr. Hill is that it would not protect the public by suppressing *bogus* patents. If an Official Examiner reports to an applicant for a "commercial" patent that his invention is not new, and that his patent would not be valid, he will merely say, probably to himself, I do not want a valid patent, and proceed till he gets the seal of the Patent Office. There is little doubt that new industries are often retarded, and the public defrauded of large sums of money, by means of these "commercial" patents. It has been said that the slow progress of the motor car industry in this country is in great part due to this cause.

The bias of the honest inventor is to reject all official advice stating that his invention is not novel. The advisory system is actually in force in Switzerland at the present time, and has been found to be practically ineffective as a means for the suppression of *bogus* patents.

No official examination for novelty can guarantee a patent from afterwards being upset in a court of law, but a very much larger percentage of patents will stand the test. The presumption of the novelty of a patented invention will be much greater, and the value of patents as a marketable commodity will be consequently enhanced.

The danger of patents for new and valuable inventions being refused through official ignorance could be guarded against by appeal. Neither in the United States nor in Germany, where patents wanting in novelty are refused, has there been any attempt to return to the *laissez faire* methods of the British Patent Office. In both these countries patents are more saleable and patent litigation is much less than with us.

X.

LEGAL.

Kirby *v.* Lawson.

In the Queen's Bench Division, before Mr. Justice Grantham and a special jury, on Tuesday, the case of Kirby *v.* Lawson was heard. It was an action brought by Mr. Frederick Kirby, civil engineer, practising in Cannon Street, E.C., to recover £2,000 commission claimed to be due from the defendant, Mr. Harry J. Lawson, a City company promoter.

Mr. Rufus Isaacs, Q.C., and Mr. Willes Chitty were counsel for the plaintiff, and Mr. Marshall Hall, Q.C., and Mr. A. P. Longstaff for the defendant.

In opening the case, Mr. Rufus Isaacs said that associated with the plaintiff in his business was a Mr. Wells. In June last year Mr. Lawson had some business in hand in connection with a company to be brought out by the Electrical Tramways Construction Syndicate, and was anxious to obtain an introduction to an engineer of considerable eminence in the electrical world, whose name might, as consulting engineer, appear on the prospectus for the issue of capital. For this service he was willing to pay a commission. Mr. Kirby had, in an earlier matter, introduced to the defendant Sir William Preece, the well-known electrician, formerly connected with the Post Office, receiving for this work his usual commission. The subject was introduced to the plaintiff and Mr. Wells by Mr. Tom Lawson, a brother of the defendant, and as a result the three of them, on August 24th, met Mr. H. J. Lawson at his office at Holborn Viaduct, where the name of Mr. Thomas Parker was mentioned. Mr. Parker would have been an extremely valuable man to have been associated with the company, both as a skilled electrician of great reputation, the manager of a large electrical undertaking, and an enterprising business man. Plaintiff at first asked £5,000 for the introduction of Mr. Parker. At that time it was contemplated taking over two of the large businesses as an electrical manufacturer which Mr. Parker carried on at Wolverhampton; but Mr. Lawson preferred to do one thing at a time, and offered to give £2,000 for the introduction, refusing to touch the matter of the businesses for the present. The introduction was duly effected by Mr. Kirby at Mr. Lawson's office. Mr. Lawson now denied by his pleadings having given the undertaking to pay commission.

Mr. Frederick Kirby, the plaintiff, was called in support of his counsel's opening. He said that at the first conversation at Mr. H. J. Lawson's office they asked for £5,000 commission for the introduction, and a share in any business, if created, but those terms were refused. Mr. Lawson offered to give "two thousand sovereigns on the table," and nothing more. They went away and discussed the matter, when they decided to accept the defendant's offer. Mr. Parker, who was at the Hotel Cecil, was brought over and introduced, and after conversing with him Mr. Lawson told them that matters had been arranged.

Mr. Marshall Hall said that Mr. Parker had all along refused to execute the agreement, and the defendant's case was that the commission was dependent on the flotation of a company, which Mr. Parker should join in the capacity of consulting engineer.

Cross-examined by Mr. Marshall Hall, the Plaintiff said that the £2,000 commission now claimed was for division between himself, Mr. Wells, and Mr. Tom Lawson. It was payable for the introduction, and nothing else. He did not know that Mr. H. J. Lawson had known Mr. Parker three years before in connection with

the motor business. Witness was not informed that there were contracts to take over some of his businesses at a large profit to himself, and Mr. Parker was trying to get Mr. Lawson to execute as a condition of his accepting this appointment as consulting engineer to the company at £1,000 a year salary.

Did not you represent to Mr. Lawson that if he got in Mr. Parker as consulting engineer, he would get for the company the order to put electrical traction on the underground Metropolitan Railway?

Witness denied this.

A letter was read addressed to Mr. Lawson, in which, describing Mr. Thomas Parker as having been characterised by Lord Kelvin as "the Edison of Europe, the most experienced and practical man there is in the profession," and mentioning the electrical project on the Metropolitan Railway, the writer went on to say: "The work alone is sufficient to make our company a record success, to say nothing of his other various businesses, which are extremely important. My own impression is that with these matters in hand we can establish the finest electrical business in existence, and to miss it would be a very great error, while Parker, I know, could find the necessary financial backing elsewhere."

Mr. Marshall Hall asked the witness: In face of that do you still say it was not a condition of the payment of the commission that Mr. Parker should enter into the contract?

Witness: Certainly I do.

Mr. William H. Wells was also examined. This witness said that before the introduction he asked for £500 on account of the commission, but the defendant replied, "No, let us do the business first."

Cross-examined: He asked the jury to believe his story that there was to be no other service for the introduction, and that he asked for £500 on account, although he knew that the introduction would take place in half an hour. Mr. Parker was a consulting engineer who could be seen by anybody on payment of a fee.

Mr. Tom Lawson, cross-examined by Mr. Marshall Hall, said he had not heard it suggested that there was any insanity in the family, but he still said that his brother promised £2,000 cash unconditionally for the mere introduction. It was known to witness that Mr. Parker had very large electrical businesses established at Wolverhampton, which he was willing to be taken over, and that there was originally a proposal to acquire them with Mr. Parker at the head.

Mr. Marshall Hall, addressing the jury for the defence, commented on the absence from the witness box of Mr. Parker, who, had he been called, would have given evidence that he declined to go into the matter unless his business were taken over, and so would have destroyed the plaintiff's case. What Mr. Kirby and his colleagues originally wanted was to get Mr. Lawson to take up Mr. Parker and his Wolverhampton businesses on a commission to them of £5,000, but that had been declined. It was proposed that the new company should start a factory for the purpose of making electrical tramways, and it was of the first importance to have a practical and scientific man of the first class, like Mr. Thomas Parker, at the head of it. Mr. Lawson wanted to get that gentleman to come in at £1,000 a year salary and bring in his influence, and if that was done he offered to pay £2,000 commission on and when the company was formed, because Mr. Kirby had represented that he had got influence with Mr. Parker as an old friend, and could persuade him to accept the appointment. It was idle to suggest that he would pay £2,000 for merely bringing two people into one room. Mr. Parker had always refused the appointment with the Electrical Tramways Construction Company unless his business was taken over, and for that reason the agreement had never been completed.

Mr. H. J. Lawson, the defendant, was called, and said he was still engaged on the scheme for electrical tramways construction. Mr. Parker was known to him before this introduction; he had met him at a motor meeting, and had travelled up in the train with him from the Midlands. Mr. Kirby represented himself as an old personal friend, who could persuade Mr. Parker to join in the scheme as consulting engineer and director, and give his weight to the company. Witness had refused at the interview to give a commission note. It was untrue that he undertook to pay £2,000 for the mere introduction, from which nothing resulted. If the plaintiff could persuade Mr. Parker to execute the agreement now, he would pay him £2,000 commission.

Cross-examined, the defendant added that the Electrical Tramway Construction Company had been in existence for some 14 years, but it was a syndicate with shares, and had not gone to the public. Its nominal capital was £250,000. It was not running tramways, but was a promoting company. He was now endeavouring to revive it. On several occasions he had tried unsuccessfully to persuade Mr. Parker to come into the company without his businesses; to acquire the latter would involve a very large outlay of capital, for which he was not prepared.

The jury found a verdict for the defendant, and there was judgment accordingly, with costs.

The National Company for the Distribution of Electricity, &c., Limited, *v.* Gibbs.

In the Court of Appeal on Tuesday and Wednesday before the Master of the Rolls and Lords Justices Rigby and Collins, the case of the National Company for the Distribution of Electricity, &c., Limited, *v.* Gibbs and another was heard on appeal by the defendant, H. O. Ruelle, from an order of Mr. Justice Cozens-Hardy. There was also a cross-appeal by the plaintiff company from the same order.

Mr. Eve, Q.C., and Mr. Rowden, Q.C., appeared in support of the defendant's appeal, and Mr. Moulton, Q.C., and Mr. Gore-Brown were for the plaintiffs.

Mr. Eve, in opening, said that the learned judge in the Court below had dismissed both the action and counterclaim, and his client only appealed from that part of the order which dismissed the counterclaim. The action was brought claiming damages for breach of an agreement, and the counterclaim sought to enforce a judgment which had been obtained in France in an action between the same parties. The standpoint which the learned judge decided was that the grant of letters patent in the ordinary form to two persons, their executors, administrators and assigns, constituted them joint tenants, and that the benefit of letters patent survived to the survivor, and accordingly that the legal personal representative of one of the joint grantees could not be sued in respect of the assignment of the patents, and could not herself sue in respect of royalties. The plaintiff company was in liquidation. It was incorporated in 1883 for the purpose of acquiring from two gentlemen, Gaulard and Gibbs, the benefit of certain letters patent, which they had obtained in respect of apparatus for the distribution of electricity by means of secondary generators. The agreement was dated May 25th, 1883, and was between Lucien Gaulard and John Dixon Gibbs, and the company. After reciting the consideration to be paid, Clause 7 of the agreement provided that the said vendors and all other necessary parties, should, at the cost of the company, execute such assignments to the company, or as they should direct, and such assignments respectively should contain a covenant by the said vendors that all the letters patent thereby assigned, were valid and in nowise void or voidable. The action was brought upon those covenants, the case of the company being that the British patents were not valid, and that so far as other countries, including the United States, were concerned, they were limited in their application. They consequently claimed damages to a large amount. As regarded the survivor, Gibbs, the action was compromised, and it therefore went on against Madame Rouelle as the legal personal representative of the deceased grantor, Gaulard. By way of counterclaim the defendant, Rouelle, set up a judgment of the Paris Court of Appeal, under which, after protracted litigation, the company was held liable to pay to her a sum of £2,600. By way of defence to the action, the defendant alleged that all the matters in dispute had been determined in the French proceedings, and that the release of Gibbs *pendente lite* was a release to the deceased man.

After hearing the arguments on both sides,

The Master of the Rolls said in this case he was unable to agree with the view adopted by the learned judge, but he doubted very much whether the practical result of the view they had adopted would be more beneficial to the parties. There were two patentees, Gaulard and Gibbs, who were entitled to certain patents for the distribution of electricity, and they agreed to sell them to the plaintiff company under an agreement dated May 25th, 1883. The learned judge had treated this agreement as neither more nor less than a joint covenant by Gaulard and Gibbs to assign these patents with a covenant of title, and he decided the case upon the short ground that Gaulard being dead there was no remedy against his personal representative, and that the claim, therefore, of the company against her failed. If the company could, therefore, only look to Gibbs, it followed that the defendant's counterclaim against the company also failed. By taking that short cut the learned judge dismissed both the action and counterclaim. He could not think that that view was correct, and what the Court proposed to do was to reverse the judgment and declare that, upon the true construction of the agreement, the right of the plaintiff company for relief against Madame Rouelle was to be ascertained upon the footing that Gaulard and Gibbs had jointly covenanted to assign the patents mentioned in the agreement to the plaintiff company, and that such assignments should contain joint and several covenants that such patents were valid, and in no wise void or voidable. Then a declaration that the amount due from the company to Madame Rouelle on her counterclaim was to be ascertained upon the footing of the order made in the proceedings in the French Courts, and with these declarations to remit the action and counterclaim for trial. They proposed to reserve the question of the costs of the action and counterclaim and of the appeal, including the costs of the plaintiff's cross appeal, to be dealt with by the judge at the trial. A point had been raised that the plaintiff's appeal was out of time, and that it had reference to a separate and distinct cause of action, but the learned judge had so linked the action and counterclaim together that they did not think they ought to be debarred on that ground. He thought counsel would do well to advise their clients to see whether they could not settle their differences by compromise, and so avoid further litigation.

THE RELATIONS BETWEEN ELECTRICITY AND ENGINEERING.*

By SIR WILLIAM HENRY PREECE, K.C.B., F.R.S.
Past-President Inst. C.E.

There are four great principles underlying the practical applications of electricity:—

1. The establishment of a magnetic field.
2. The establishment of an electric field.
3. The disturbance or undulation of the æther.
4. The work done by the generation and maintenance of electric currents in material systems.

* Abstract of the "James Forrest" lecture to the Institution of Civil Engineers, delivered April 23rd.

Electricity is purely mechanical in its effects. It requires matter to render it evident to the senses. Its transference is characterised by motion, chiefly undulatory when we consider the æther, but partaking of the most known forms when considering conductors and insulators. It is therefore essentially a dynamical agent in the hands of the engineer to carry out his duties.

(*a*) *The Application of Force.*—Electricity enables the engineer to direct energy to great distances, and there to apply force at his will. Force is that which produces, or tends to produce, motion. It is the function of the engineer to utilise this motion.

Dynamos and motors are subject to laws and conditions so thoroughly well known that exactness is assured and waste reduced to a minimum. There is no more perfect machine than a dynamo. Motors are nearly as good. Electricity as a science is fascinating to everyone, but it is deeply fascinating to the engineer.

(*b*) *The Doing of Work.*—The maintenance of an electric current through the conductor means the expenditure of work upon that conductor, and this expenditure of internal work means molecular motion. In solid conductors the result is *heat*. If the current be gradually increased, this motion is similarly increased. The result is successively incandescence, white heat, fusion, and disruption.

Joule established the law of the relations of current and heat upon a definite and accurate basis.

Faraday developed the laws of electro-chemistry with equal exactitude.

Prof. J. J. Thomson has determined the action of currents on gases.

The principle of work that lies at the very root of the profession of the engineer enables all these operations to be measured in definite mechanical units, reducible to the common English standard, the *foot-pound*, but which the electrical engineer, with greater precision, refers to the scientific unit of work—the *Joule*.

(*c*) *The Purification of Matter.*—The electric current has proved to be a powerful agent to break up crude materials into their useful and useless constituents. The electro-chemical industries of the world are very extensive.

According to Prof. Borchers, the eminent electro-metallurgist, the world manufacture of calcium carbide for the production of acetylene gas is utilising a power equal to 180,000 H.P.; that of the alkalies and the combinations of chlorine for bleaching, 56 000 H.P.; of aluminium, 27,000 H.P.; of copper, 11,000 H.P.; of carborundum, 2,600 H.P.; and of gold, 455 H.P. Electro-plating is one of the staple manufactures of Sheffield and of Birmingham. There are nearly 200 firms working at the former place, and over 100 at the latter.

The decomposing bath and the arc furnace are revolutionising many industries. Phosphorus is now being produced in England in large quantities from corundum, and aluminium from bauxite is extending in use and being reduced in price. The Post Office is using aluminium for telephone circuits. I have recommended its use on a very large scale in the interior of Africa, where transport is so costly. We can get the same conductivity as with copper with half the weight, and at less price, and we can put up a line telegraphically ten times better than of iron for less money.

(*d*) *The Annihilation of Space.*—In wires of great length, while the initial speed is that of light, it takes time for the electric waves to rise and fall, so that the number of currents which can be sent per second is limited. Between London and Liverpool the speed of speaking is virtually unlimited, but between Ireland and America it is restricted by the so-called *capacity* of the cable submerged in the ocean. This capacity absorbs energy and retards the rate of rise and fall of currents. While 1,000 currents per second can be sent in the former case, only six per second are available in the latter.

Nevertheless, sitting on the shore of the Atlantic in Ireland, one can manipulate a magnetic field in Newfoundland so as to record simultaneously on paper in conventional characters slowly written words. Thus we have bridged the ocean and annihilated space. Not only is speech reproduced but handwriting also. Town is connected with town and nation with nation. London and Paris, Paris and Berlin, Berlin and Vienna, speak to each other with clearness and distinctness in ordinary language. The scattered British Empire is linked together. London and New Zealand are in communication with each other.

The regulation of the ever-growing traffic on our railways and the safety of passengers is secured by similar means. The telegraph not only places the manager of the line in communication with every station upon his system, but electric signals control the motion of every train. Trains are kept apart by a considerable space. Collision would be impossible were the human will infallible; but the world is made up very much of fools and temporary maniacs. A railway signal-box is an electrical exhibition. Every line is protected by its own electric signal. Every distant outdoor mechanical signal is repeated back. The danger signal is locked and cannot be lowered to "line clear" until it is unlocked by the train itself or by the distant signalman. Mr. F. W. Webb (member of Council) is not only working the outdoor signals themselves by electrical energy, but he is moving the points and switches by the same means. So far the experience gained at Crewe during a period of about 12 months, from the working of a signal cabin containing about 60 levers, has been such as to justify confidence and the extension of the system, and some 10 cabins, containing about 1,000 levers, will be provided. The apparatus has been designed to work in with, as far as possible, the standard signalling apparatus of the London and North-Western Railway. The interlocking frame may be said to be the ordinary mechanical frame in miniature, occupying one-third of the space. The levers—about 6 inches in length—are placed in two tiers, and are manipulated in the same way as the levers of a mechanical frame, consequently the signalman accustomed to the old type has nothing to learn in the new. The levers are mechanically locked by means of tappet locking, and they control carbon switches by which the 110-volt electric current is transmitted to the motors.

The object of this electric working is primarily to reduce the manual labour of the signalman, and enable him to pay more attention to the movements outside his cabin, increased speed of working, the removal of obstructions on the ground caused by the numerous wire and rod connections necessitated by the present system, and finally, a reduction in the number of signalmen employed.

Thus electricity adds to the security of life. It supplies the railway man with a new sense, and the engineer with a new power.

The abridgment of time necessarily follows from the annihilation of space, but the chief element which saves our time so much is the fact that we can, by electricity, do so much more from one spot. Indeed, in the United States the railway companies complained that their revenue between New York and Chicago suffered through the introduction of the telephone. People remained at home and did their business by wire.

Wireless telegraphy, or, as it is better termed, setheric telegraphy, has made but small progress, owing to the simple fact that the demands for its services are so very few. There is no commercial business in it.

(*e*) *Transmission of Power.*—The property that an electric current possesses of converting its environment into a magnetic field, and the fact that the projection of a magnetic field through a conductor induces an electric current in that conductor, are prolific of many valuable instruments by which we transform energy into different intensities, and thus economise the cost of its transmission. The higher the voltage the smaller the amperage, and hence the less the weight of copper needed. The present practical limit of voltage along aerial conductors appears to be 40,000 volts. Beyond this pressure the dielectric strength of air breaks down. Higher voltages are practical in insulated mains, but their expense is a ban to their use.

It is not considered advisable to construct dynamos giving higher voltages than 2,500 volts, although in many cases 5,000 volts are produced; but these high voltages are easily and safely converted by transformers to any other higher pressures.

Energy is also transformed in its continuous form by rotary converters, but in this case the process is usually the reverse. Direct continuous currents of 100 amperes and 3,000 volts are reduced to 500 volts by acting as motors to rotate generators, giving 600 amperes, for, say, tramway working. Again, at Tivoli, 18 miles from Rome, the energy of the falling water there is transmitted to Rome in the form of alternating currents at 6,000 volts, and is there converted by rotary transformers into direct currents at lower voltages for battery, traction, and motive purposes.

Falling water can, by a turbine or impulse wheel, convert the energy it possesses in virtue of its fall into the form of electricity. By the aid of transformers it can be raised to very high voltages; 40,000 volts is employed in California, 11,000 in Niagara. We use 10,000 between Deptford and Trafalgar Square. It can thus be transmitted to any reasonable distance, and there it can be utilised to do useful work. The waste forces of Nature are thus within our reach. The waterfalls of the Highlands may work the tramways of Glasgow; Niagara already works those of Baltimore.

The economy of this system for large industries is a question of the relative cost of the generation of energy by other means. Energy on the coal fields can be produced cheaper by burning coal than by any water scheme that I have yet examined in this country. The price and abundance of coal renders the transmission of energy to great distances at present a very limited question indeed. Where coal is scarce and dear and water abundant, as in Switzerland, water-power is very much utilised. Where coal is abundant and cheap, as in England, it is uneconomical to adopt it. The transmission of power within limited areas by electricity in our cities is now within the range of practice. In Edinburgh it is supplied at the rate of 1½d. per unit; this is 0·83d. per horse-power-hour. It is invaluable for small industries. It is there ready to be used when it is wanted; it wastes nothing while idle.

The economy and efficiency of distributing power over mills, factories and workshops by electricity instead of by shafting, gearing and belts, is so pronounced that the change is being effected in every country with great rapidity. If it were a question of the mere efficiency of the two systems, the advantage of the change would not be so obvious; but it is shown by the horse-power-hours expended, which means the coal bill. The efficiency of an electrical system is rarely less than 75 per cent., while that of shafting is frequently as low as 25 per cent.; but the economy is the continuous waste of the latter that tells on the coal bill, while in the electrical system there is no such waste. The motor runs when it is wanted, and expends only what energy is wanted for the particular work to be done.

Every up-to-date shop should have its electric plant for healthy light, cheap power and handy distribution of material. Its economy is demonstrable in the smallest, but in the largest shops it is at once most marked. It is always available and it costs little. Ignorance or timidity restricts its use very much. The number of works that are run by electric motors in different parts of the country is very large indeed. The efficiency, handiness, and economy of doing so is so marked that the practice is extending with great rapidity. Motors themselves are being daily improved.

We underrate very much the progress made in the United Kingdom in different industries, owing to the secretiveness of the British manufacturer. He will not report what he is doing in the Press, and the Press leaves him severely alone. Electricity as an economiser, by increasing the speed of output, and by reducing waste, is as much at the disposal of the British as of the American manufacturer. But John Bull clings with affectionate and conservative fervour to the capital expended by his grandfather, while Uncle Sam does not hesitate to chuck obsolete plant on the scrap heap, if, by doing so, he can increase his business.

On the Clyde and the Tyne, and, indeed, wherever shipbuilding is flourishing, there we find electrical energy driving machine tools,

holding up plates, and assisting in various processes. In many large machine works cranes and travellers are moved by it.

At Boston, U.S.A., crossing the Charles River, and uniting Charlestown, the scene of the famous battle of Bunker's Hill, with its headquarters, is a new bridge 100 feet wide and 1,920 feet long, having a draw of 240 feet span, weighing 1,200 tons. This draw is opened and closed by electric motors.

In the Post Office we have introduced electric motors very largely. At Leeds they are used for driving pneumatic pressure and vacuum pumps, employed there to work the pneumatic tube system. They are also used for working automatic stokers, ventilating fans, and lifts.

(*f*) *Traction.*—It is for traction purposes that electricity is making such gigantic strides. In the United States tramway working by its means has become practically universal. In the United Kingdom it is making rapid way, and in connection with electric lighting it is giving great economical results. The combination of the two systems is most effective. In St. Helens, in Lancashire, where 13,435 8-C.P. lamps are connected, and a small tramway system of nine cars simultaneously running is at work, the works costs have been brought down from 3·23d. per unit to 0·67d. per unit. The price for electric light has been reduced from 6d. to 4½d. per unit, and it will probably be lowered to 3½d. This is after only 8½ months' working. St. Helens is an object lesson to all municipalities, especially to Glasgow, where a very false start has been made.

Electric railways are also growing apace. A bold attempt is being made by the Metropolitan railways to work the existing line in such a way as not to interfere with the existing traffic or even with the permanent way. A new train of six coaches weighing 180 tons, having a motor car at each end weighing 54 tons, is about to run between Earl's Court and High Street, Kensington. Each motor car is mounted on bogies, and each bogie has two electric motors, so that there are eight driving wheels, each bearing 6·75 tons. The driving wheels have diameters of 47 inches. The length of the train is 240 feet. Each motor is rated at 200 H.P., or a total of 800 H.P. for each motor car. But there is a wide margin, and we have already applied 950 H.P. in starting a load of 270 tons on the incline of 1 in 43. Electric traction has an immense advantage over steam traction in impressing a continuous and uniform torque or turning moment on the shaft, and consequently a continuous and uniform effort on the trend of the wheel. The action of the steam locomotive is intermittent and the bite not continuous. Hence such frequent slipping on greasy rails. Again, the maximum torque can at once be applied by the current, and, in combination with the constant effort, it increases the acceleration so that a train acquires its maximum speed much more quickly. We shall increase the mean speed of the Metropolitan trains from 11 miles per hour to 15, and thereby increase the capacity of the line over 30 per cent. The stoppages on the underground railways are so frequent that the trains are always either accelerating or stopping. They never reach their top speed as they do on main lines. Electric traction enables them to start quicker and stop more promptly. On the Metropolitan the 180-ton train acquired 20 miles an hour in 200 feet, and, when going at the same speed, it was stopped in 130 feet—half its length. Smart work on such a railway depends on the rate at which trains can be emptied and filled. The English system of compartments and side doors facilitates this. It would be still further expedited if we could have one platform for entry and one for exit, and one class only.

The Liverpool and Manchester Lightning Express Railway, promoted by a very powerful representative syndicate of those two great commercial centres to carry out the scheme of Mr. Behr, is a very bold and promising venture. The line is to be monorail, 34 miles long, direct between the two cities, without any intermediate station, and with no crossing. There are to be cars every 10 minutes. The speed is to be 100 miles per hour, and the time of transit 20 minutes. I know of no reason why this should not be done with safety and comfort.

The automobile car of the future has not yet seen the light. It will be electrical. Immense progress has been made in motors and in batteries. Lundell has shown how to store up the energy now wasted in descending hills, and to recover some of that absorbed by the inertia of the car. Although a battery has already been able to drive a car 100 miles with one charge, we are waiting patiently for the real automotor storage cell.

(*g*) *Electricity in War.*—A strong contingent of electrical engineers has volunteered for service in South Africa. They are all scientifically-trained practical young engineers. Bicycles, field telegraphs, telephones, arc and glow lamps, cables, searchlights, traction engines and generating plant will be under their care. It is strongly hoped that we may soon hear good accounts of their performances at the front. They are under the command of Major Crompton, a member of the Institution and an old soldier.

Electricity has been extensively applied to the development and utilisation of explosives in both the civil and military divisions of our profession. Charges are safely fired under water and blasted in mining and demolition operations by small exploding dynamos, magnetic-electric machines or induction coils acting upon high tension fuses. Our honorary member, Sir Frederick Abel, has especially distinguished himself in this direction. His fuse, composed of phosphoride and subsulphide of copper, is universally used by our War Department. Time guns are thus fired at stated hours at different seaports by currents originating in Greenwich Observatory. Broadsides in battleships and guns in turrets are similarly discharged. Torpedoes are even directed by currents from the shore. The defence of our coasts by submarine mines and their explosion by currents when the enemy's ships are properly located by position-finders is the last development of the application of electricity to war.

Electrical blasting had revolutionised the operations of tunnelling and driving galleries. It is much used in quarrying with great security to the men. The deepening of harbours and channels and the removal of obstructions, such as wrecks and rocks, are facilitated. On September 23rd, 1876, 63,135 cubic yards of solid rock were completely demolished by one discharge at Hell Gate in East River, New York. The preparation for this great blast took four years and four months. There were 4,427 charged holes, each containing its mercury fulminate fuse and charges of dynamite. There were 49,914 explosions used in that one blast. Batteries were used to generate the currents, and they were arranged in large groups. Each battery exploded 160 charges. This was the record blast.

The battleship is the home of electricity. It controls the rudder, it ventilates the interior and the living space of the ship, it forces the draught and assists the raising of steam, it revolves the turrets, it trains and controls the fans, it handles the ammunition, it purifies the drinking water, it lights up the ship internally, it enables the captain to sweep the horizon with the brilliant rays of the searchlight, and to communicate with his tender or with his commanding officer across space independent of weather, night, season, fog or rain.

(*h*) *Sanitation.*—No branch of our profession fulfils the true function of the engineer more efficiently than that which deals with sanitation. Pure air, pure water, pure food, pure soil, pure dwellings, and pure bodies are the panacea for health and comfort. Electricity helps us very much in attaining some of these qualities. An electric glow lamp does not vitiate the air. The air vitiated by our lungs can be easily withdrawn and fresh air can be forced in by fans worked by electric motors. Even the air during its entrance can be warmed, and impurities floating in it can be sifted out of it by the attraction of electrification.

Heating by Dowsing's luminous electric radiators is very much on the increase; they consume 250 watts, which cost about ½d. per hour.

In many post offices sealing wax is melted and kept in a liquid state by currents.

Water can be sterilised by ozone, a product of electrification, and even by the nascent oxygen, when broken up into its constituent elements by electric currents.

Sea-water thus electrolysed supplies us with chlorine, and converts the water into a powerful antiseptic, disinfectant, and deoderiser. Its economy is, however, doubtful, and in consequence its adoption has been much restricted.

(*i*) *Industries.*—The applications of electricity to other industrial processes are innumerable. I have time to mention only one. Mr. T. A. B. Carver, who was a pupil of Lord Kelvin and an officer on our staff in this Institution, has brought out a new Jacquard loom for weaving; 600 hooks are controlled electrically. The twill as well as the pattern is under complete management. It has been warmly taken up in Glasgow, and a factory has been started there.

The pattern on this cloth is woven directly from a photo-print of the artist's design, mounted on a metallic sheet. The threads of the warp being picked up by electro-magnetic action, owing to the figure of the pattern being cut away, and thus allowing the circuit to be completed by the metallic sheet.

The theme of the relations between electricity and engineering is too great for an hour's discourse. Electricity tends to economise labour and to cheapen the cost of living. It increases national wealth and promotes international friendship. It enlightens the invisible, and it alleviates suffering. It conduces to avert war, and it certainly facilitates the conclusion of peace. Its practical applications have run *pari passu* with our revered Queen's reign. They are growing with great rapidity. Who can forecast the future? One simple lesson that I have learnt is that in the practical developments of electricity the only thing that occurs is the unexpected.

There is now a distinct line of demarcation separating the physicist from the engineer. The former dives into the unknown to discover new truths; the latter applies the known to the service of man. Research is the function of the one; utility that of the other. In the past the engineer had to rely on himself for his facts, but the advance of modern science, the growth of technical education, the formation of laboratories, and the endowment of Chairs have changed all that.

Smoke Nuisance.—On 19th inst., at Newcastle Police Court, the Newcastle-upon-Tyne Electric Supply Company, Limited, were charged, at the instance of the Newcastle Corporation, with causing a nuisance at their works at Pandon Dene by their "furnace chimneys sending forth black smoke in such quantity." Mr. Burton, for the defence, called Mr. Donald Walker, the defendants' engineer, who said his firm had nine boilers in the works, and 18 furnaces, and there were two chimneys, one of which was 110 feet high, and the other 120 feet high, the latter having been erected this year. He spoke of the apparatus used for keeping down the smoke, and said much money had been spent to obviate any nuisance. The furnaces were all properly constructed. Not to his knowledge had on any occasion a nuisance been caused by the smoke. He had watched the chimneys a great many times. Mr. Walker added that the smoke was caused by the extra stoking of the furnaces required to meet sudden and exceptional pressure, and was unavoidable. Mr. Burton submitted there was no nuisance. Whatever smoke was emitted seemed to be very small. He added that the company were applying to Parliament for powers to remove the works from Pandon Dene to a district outside the rateable area of the city of Newcastle. An order was made for prohibiting a recurrence of the nuisance.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending April 25th, 1899.		Week ending April 24th, 1900.	
Alexandria	Value £10	Adelaide	Value £14
„ Teleg. stores ..	50	Alexandria	24
Amsterdam	75	Amsterdam	50
Bombay	50	Auckland	101
Boulogne	51	Bombay	336
Buenos Ayres	1,100	„ Teleg. mat.	83
Calcutta	885	Buenos Ayres	42
Cape Town	164	„ Teleg. mat. ..	94
Colombo	138	Calcutta	2,062
Copenhagen	110	„ Teleg. wire ..	655
Demerara	13	Callao Teleg. cable ..	15,000
Durban	964	Canterbury	11
„ Teleg. mat.	1,716	Cape Town	71
Gothenburg	88	Channel Islands	115
Hamburg	225	Chinde	12
Madras	186	„ Teleg. mat.	854
Mauritius	25	Christchurch	28
Melbourne	95	Colombo	267
„ Teleg. mat.	4,421	Copenhagen. Teleg. wire ..	121
Odessa. Teleg. mat.	50	Durban	101
Otago	42	„ Teleg. apparatus	882
Port Elizabeth	397	East London	75
„ Teleg. mat. ..	75	Flushing	78
Rotterdam. Teleg. mat. ..	35	Fremantle	25
Shanghai	102	„ Teleg. mat.	17
Singapore	96	Gibraltar	11
Sydney	254	Hamburg	38
Tientsin	14	„ Teleg. mat.	400
Wellington	111	Launceston	200
„ Teleg. mat.	89	Madras	131
Yokohama	130	Mauritius	75
		Melbourne	62
		„ Teleg. mat.	50
		Odessa. Teleg. mat.	80
		Ostend	15
		Port Chalmers	58
		Port Elizabeth	100
		Rotterdam. Teleg. mat. ..	100
		St. Vincent. Teleg. cable	163,000
		Shanghai	310
		Sydney	1,180
Total ..	£11,261	Total ..	£186,878

Foreign Goods Transhipped.

Melbourne. Telephones ..	Value £44	Colombo. Elect. mat. ..	Value £29
Trinidad. Elec. light apparatus	83	Hamburg. Elect. mat.	100
Total ..	£137	Total ..	£129

Apology for Infringement of Rights.—In our advertisement pages this week will be found an apology by Messrs. Elgood Bros., of Leicester, for having supplied goods described by them as of the manufacture of Messrs. W. A. S. Benson & Co., being electric light fittings which were not of Messrs. Benson's make, but "of inferior quality."

Auction Sale.—On May 22nd, Messrs. Edwards, Son and Bigwood, will sell by auction at Birmingham the lease of the manufacturing premises of the Birmingham Carbide Company, also engines, boilers, &c. See our advertisement pages to-day for details.

An Automobile Directory.—Amongst the publications of all kinds that owe their existence to the recent development of automobilism, the "Annuaire Général de l'Automobile," a directory dealing with the motor car and all the industries connected with it, and published every year by Messrs. Thévin & Houry, recommends itself particularly to the attention of electricians. The 1899 edition contained more than 1,200 pages 8vo, and a new edition is now in course of preparation, and will appear next month. It will contain all addresses relating to the construction, the selling, and the practical working of motor cars in Europe and the United States.

Automobiles at the Agricultural Hall.—The Exhibition of Automobiles which closed last Saturday was the most extensive that has yet been held in this country. Some idea of its extent may be gained from the fact that the exhibitors numbered 60 to 70, the greater part being engaged in the motor car building or equipping business or in the supply of accessorial parts. But although from the point of view of general progress the exhibition is encouraging, the abundance of petroleum and steam vehicles and the very small proportion of electrical ones brings home to one very forcibly how lamentably backward is the application of electricity to the automobile in this country. We have witnessed several of these Agricultural Hall motor car shows, and we rather fancy that the number of electric carriages was as great at the earliest exhibition as at that of 1900. It should be remarked that the exhibition which closed last week, though directed by Mr. Cordingley, was under the auspices of the Automobile Club, and therefore may be regarded as fairly representative of the industry. One could not fail to notice an improvement in the design and general appearance of the later vehicles, which it is very satisfactory to record, for the uncomeliness of the motor car has up to the present brought it to be regarded as a "one-horse" affair. There were several firms with exhibits of dry batteries and parts for electrical ignition purposes, electric head and side lights. Messrs. Peto & Radford had a stand devoted to these; Le Carbone showed the "Sans Pareil" cells, and the "Meyra" Electric Company exhibited the "Meyra" dry batteries. The Hart Accumulator Company, Limited, had an excellent showing of their batteries at the hall entrance. Among the exhibitors of electromobiles were Messrs. Shippey Bros., who showed the Canadian vehicles on the "Still" system; Mr. Oppermann, who exhibited the "Lucania" electric dog cart; Headland's Battery Company; the Joel Engineering Company; the Electrical Undertakings, Limited, and others. The public interest taken in these exhibitions has increased considerably, in fact they are becoming quite popular.

Bankruptcy Proceedings.—In *re* E. Bates, electrician, Warrington: First meeting, May 2nd; public examination, May 28th, both at Manchester.

Liquidations.—The "Perfect" Arc Lamp and Accessories Company, Limited, of Westminster, is winding up voluntarily, with Mr. Sydney H. Lee as liquidator.

Creditors of Cuttriss, Wallis & Co. must send particulars of debts, &c., to the liquidator (Mr. J. W. Close, Greek Street Chambers, Leeds) by June 6th.

Books Received.—"Power Transmitted by Electricity," by Philip Atkinson. London: Crosby Lockwood & Son. 7s. 6d.

"Traité élémentaire d'Electricité," by R. Colson. Paris: Gauthier-Villars. 3 fr. 75 c.

Journal of the Institution of Electrical Engineers, No. 144. London: E. & F. N. Spon, Limited. 3s. 6d.

Catalogues and Lists.—The British Westinghouse Electric and Manufacturing Company has issued its Circular No. 1,025 entitled "Alternating Current Fan Motors—for 50 and 100-volt circuits." The company has also reprinted in pamphlet form from the Electrical Review, a copy of the Presidential Address of Prof. S. P. Thompson to the Institution of Electrical Engineers. The title of the pamphlet is "Present Electrical Tendencies." Circular No. 1,024 of the British Westinghouse Company is entitled "Direct Current Switchboards, Type 7, 110 to 250 volts." It is fully illustrated with diagrams. Circular No. 1,026 deals with "Compensators for A.C. Circuits."

The British Steam Specialities, Limited, have brought out their catalogue No. 1, in which they describe their modern appliances used in the steam heating trade. The company has secured the rights to manufacture in this country the Kieley and Mueller and other goods which have found favour in heating circles in the United States and Canada. A glance through the list shows reducing valves, steam traps, water pressure regulators, grease extractors, damper regulators, temperature controllers, feed water heater, relief and drain valves. There are several pages of serviceable information in tabulated and general form for the benefit of steam users, at the end of the pamphlet.

From Husson's Safety Acetylene Syndicate of Victoria Street, we have received a catalogue of the Husson's safety acetylene generators. Notes on the generation of acetylene, and the efficiency and cost of working, preface illustrations and details of the generators, holders, and purifiers and the accessorial fittings. A sectional view shows the general principle of the plant.

Charge of Incendiarism at Silvertown.—At the West Ham Police Court on 21st inst., Christian Maddock, 30, an electrical wiremen, of Silvertown, was charged with unlawfully and maliciously attempting to set fire to a building and contents at Factory Road, Silvertown, the property of the India-Rubber and Gutta-Percha Works, Limited, with intent to set it on fire.—Mr. F. Stern, who prosecuted, said the prisoner had been employed at the Silvertown India-Rubber and Gutta-Percha Works for about four months as wireman. The offence with which he was charged was of a very serious character, and but for the carefulness of another employé the previous afternoon there would have been a most serious conflagration. There had been no fewer than six fires during the last 12 months at the works, but though, of course, it could not be suggested that the prisoner knew anything about them, in view of this charge it would be noticed as a remarkable fact.—Alfred May, of 77, Cleaver Road, Custom House, a pattern storekeeper at the works, said that on Friday afternoon soon after two o'clock he was in the pattern room—an apartment 41 feet by 132 feet, in which were stored about 18,000 patterns, all of wood. The prisoner came in and asked if the witness had seen his foreman, and he stood for some time talking, his conversation including remarks about a fire at Henley's Telegraph Works, which broke out on Good Friday night. He said he was the first man there with the firemen, that he assisted them in putting out the fire, that he had saved some rubber, and had turned off the gas. The witness was called downstairs, and the prisoner left the room with him. The witness returned to the room in about half an hour, and the prisoner came in five minutes later. The witness concealed himself, and saw the prisoner walk round to where they had previously stood. He took up a pattern—the shape of a flower-pot saucer, and did something which the witness could not see. He put the saucer by the side of the box and then went out. The witness found that the pattern contained about three-quarters of a pint of methylated spirits, and called his foreman, M'Kennedy, and also Mr. M'Nault, the engineer.—John Pattison, of Twyford Street, Stratford, a foreman at the works, said that the prisoner was under his orders, and had no business in the pattern room on Friday. After he had been charged the witness saw the box produced on the floor. It was mouth downwards, and on lifting it he found a candle stuck in a bit of wood, which was partially covered with cotton waste. The waste was saturated with methylated spirit, and across it was an uncorked bottle half full of methylated spirit. The candle had been freshly trimmed, was ready for lighting, and a piece of the wax was lying close by. The bottle containing spirit was a glass ginger beer bottle, and it was kept in its position on the waste by a small piece of wood, used as a pattern. The prisoner would have the use of methylated spirit and cotton waste in his work.—William Williams, a lad of about 17, the prisoner's boy at the works, said that about mid-day on Friday the prisoner sent him to the store for some methylated spirit and cotton waste. He got about a pint of the spirit and about ½ lb. of waste.—After some further evidence the police asked for a remand, which was granted.

Electric Fans in Calcutta.—*Indian Engineering* has the following paragraph:—"This device has come to stay in Calcutta. The demand for fans has been so great that the supply is totally inadequate to meet calls. The fans that have been installed are American, but in a few years, we may presage, England will wake up and begin making them."

Electric Lamp Manufacture in Spain.—A company has just been formed in Brussels, with a capital of £40,000, and the title La Sociedad Fabrica Nacional de Lamparas Electricas de Incandescencia, to manufacture incandescent lamps in Spain.

Engineers' Wages on the North-East Coast.—We read in the *Times* that the representatives of the Amalgamated Society of Engineers on the north-east coast have addressed a letter to the Engineering and Shipbuilders' Employers' Association asking that the application for an advance of wages, which a few weeks ago the masters said they could not concede, should be reconsidered. The members of the United Kingdom Society of Amalgamated Smiths and Strikers employed in shipyards on the Tyne, who asked that, from Saturday last, the wages of smiths should be advanced 10 per cent., on time rates, and 7½ per cent. on piece rates, and the wages of strikers 10 per cent. on time rates, have been informed that their request cannot be granted.

Fire.—Last Saturday a small fire occurred at the Endell Street premises of Messrs. J. H. Heathman & Co., but they being specialists in fire extinguishing appliances every precaution had been taken and the damage was very slight indeed.

For Sale.—The Newport (Mon.) Corporation has an amount of disused plant for sale.

Heathman's Ladders.—Two telescopic tower wagons for Blackburn, one for Darwen, five for Poplar street lighting, two for Kensington street lighting, and one for the Paddington Vestry lighting are among recent orders received by Messrs. Heathman and Co.

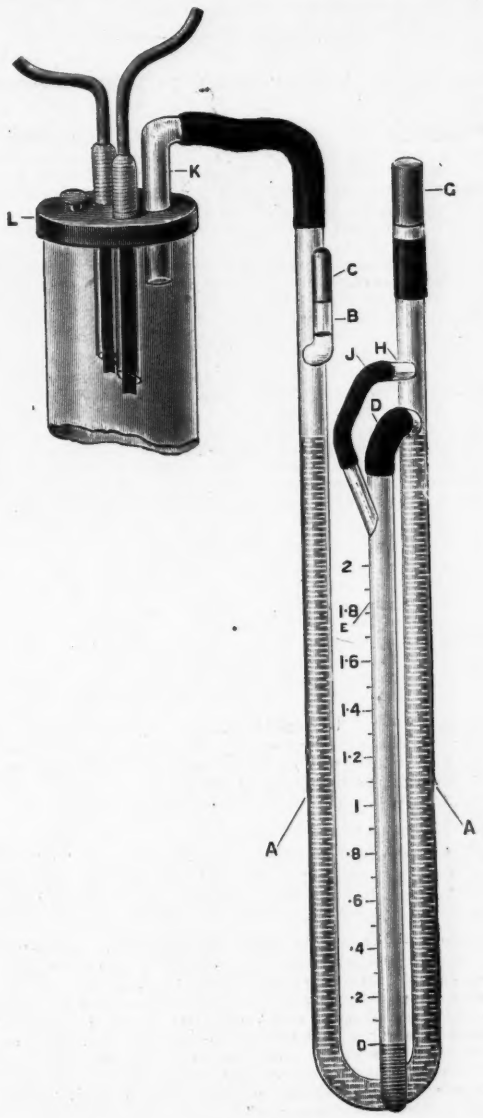
Municipal Electrical Association.—The Huddersfield Corporation has agreed to allow the Municipal Electrical Association the use of the Town Hall for its annual convention in June.

Parliamentary Bills.—Notice appears in the *London Gazette* of a petition by the promoters of the North Metropolitan Electric Power Supply Bill for additional provision to authorise the compulsory purchase of lands at Enfield for the construction of a generating station.

The Parsons Turbine.—We see in the German and Swiss papers a notice to the effect that the firm of Messrs. Brown, Boverie & Co. and the Parsons' Foreign Patents Company, Limited, have entered into a contract for the manufacture and sale, for electrical purposes, of the well-known Parsons steam turbine in the following countries:—France, Germany, Russia, Switzerland and Italy, and simultaneously the official registration of the company constituted to carry out this business has appeared in the Zurich Government *Gazette*. The style of the company is Aktien-Gesellschaft für Dampf-Turbinen System Brown-Boveri-Parsons, with its head office at Baden, Switzerland. This combination is all the more important in view of the position Messrs. Brown, Boveri & Co. hold on the Continent as manufacturers of various types of dynamos. The extraordinarily efficient results obtained from some plants now constructed at the Heaton Works for the Continent, have, no doubt, been the chief factor in bringing about this arrangement with a firm of such standing as Messrs. Brown, Boveri & Co. The following figures, extracted from the official returns of the exports of Switzerland, show that the firm of Brown, Boveri & Co. on a total export of 4,285 tons for 1898 contributed alone 1,917 tons, or 45 per cent., and in 1899, out of a total of 5,765 tons, they contributed 2,949 tons, or 51 per cent. Taking the proportion of increase over the year 1898, *i.e.*, 1,500, we find that Brown, Boveri & Co. participate in this increase to the extent of 1,000 tons, or about 67 per cent.

Summons against the National Telephone Company.—At Southwark on Monday, Mr. Johnson, clerk to the Vestry of St. George-the-Martyr, applied to Mr. Paul Taylor for a summons against the National Telephone Company for breaking up the roadway in Marshalsea Road, Borough, on the early morning of April 1st. He explained, says the *Times* report, that the application was made under Section 109 of the Metropolis Local Management Act. Mr. Paul Taylor: Did the company act under statutory powers? Mr. Johnson: No. This application is made on the strength of the advice given by the Judge in the case of "Battersea Vestry *v.* The Brush Electric Lighting Company." In that case the Vestry applied for an injunction to have pipes removed which had been placed down without authority. The Judge refused the order, but suggested that if a summons had been taken out under Section 109 of the Metropolis Local Management Act the result would have been different. In this instance the company did not give three clear days' notice of their intention to break up the road, although they had been negotiating for years for permission. The Vestry, however, withheld their consent except upon certain fair conditions. Mr. Paul Taylor granted the summons.

Rimington's Maximum Demand Indicator.—The indicator which we illustrate herewith has been specially devised to work in conjunction with the Bastian ampere-hour meter. To this end, the stopper, L, fig. 1, of the meter is made perfectly gas-tight, and the gases resulting from the decomposition of the electrolyte in the meter are led by a tube K, into the U-tube A A', which is filled with coloured liquid up to the level shown in the figure. The branch tube B is closed at the upper end by a porous plug C, through which the gas generated in the meter must escape. The rate at which the gas passes through the plug is proportional to the pressure of the gas, while the rate at which the gas is given off is proportional to the current flowing through the meter; as these two rates must eventually become equal for a steady current, it is evident that the pressure of the gas must bear a definite proportion to the



current. The column of liquid in A consequently falls, while that in A rises and overflows through D into the trap E in front of the scale, the amount of overflow affording a permanent indication of the maximum steady current that has passed through the meter. The free end of A is closed by a plug G, whose porosity is regulated by the length of time lag required to avoid penalising the consumer for a transitory excess current. To re-set the instrument, the rubber tube, J, is detached from the nozzle, H, and E is raised so as to allow the liquid to flow back into A. The tubes J and E are then replaced and the instrument is ready for the next registration. The simplicity of the device is as striking as the ingenuity of its conception, and the cost of manufacture is very moderate. The uniformity of the demand scale, and the fact that no power is wasted in the indicator, are also good features. The instrument is made by the Bastian Meter Company, Limited, Kentish Town.

Theft.—At the Hull City Sessions on 20th inst. two men, named Elwee and Monkman, were sentenced to a term of imprisonment for stealing a quantity of electric light fittings from Messrs. Reames, Wokes & Co.

Trade Announcement.—Mr. S. W. Cuttriss has opened an office at Prudential Buildings, Park Row, Leeds, where he will practice as an electrical and scientific expert. Having been requested by friends to continue the supply of the specialities in electro-motors of the firm of Cuttriss, Wallis & Co., Limited (*in liquidation*), he has made arrangements to continue their manufacture. Mr. Cuttriss claims a lengthened experience of the electrical trade, and familiarity with electric lighting, the transmission of power in factories, &c.

Wells Lights and the War.—We understand that Messrs. A. C. Wells & Co. have just shipped out to St. Helena for the Government 30 of their "Wells Lights," which are to be used for the purpose of lighting up the enclosures in which the Boer prisoners are enclosed. Wells lamps are also used for the same purpose at Cape Town, and they are rendering great service in railway construction in South Africa, as well as having been fitted to all the siege trains.

ELECTRIC LIGHT AND POWER NOTES.

Brighton.—At a recent meeting of the Council the following report was presented:—The Lighting Committee report that since the meeting of the Council on April 5th they have further considered what arrangement it is advisable to make with a view to retaining Mr. Wright's services as manager of the Corporation electricity undertaking, and have consulted Mr. Wright on the question. The Committee beg to recommend that Mr. Wright be retained as consulting engineer and manager, and remain responsible for the whole management of the undertaking, at a salary of £600 per annum. Mr. Wright will bind himself to the Corporation to remain on these terms for five years, but the appointment will be determinable by the Corporation on three months' notice. Mr. Wright undertakes that during his absence from England at any time, he will, at his own cost, appoint a duly qualified electrical and civil engineer to act for him in case of emergency. The Committee further recommend that, in view of the probability of Mr. Wright being absent from Brighton for more or less lengthened periods from time to time, a resident manager be appointed, who shall be subject to Mr. Wright's control and direction, and that an advertisement be issued for applications from candidates for the appointment, and requiring candidates to state their qualifications and salary required. After some discussion the report was adopted.

Cardiff.—The Electric Committee met last week to consider applications for the position of mains superintendent. Nineteen candidates responded to the advertisement, and the committee reduced this number to three. The position carries a commencing salary of £150 a year. The three candidates chosen to appear before the committee on May 3rd for final selection were:—Mr. E. Jones, the deputy to the ex-superintendent, who has been doing the work satisfactorily for some weeks, according to the electrical engineer; Mr. H. D. B. How, London; and Mr. W. H. Illingworth, Halifax.

Cheadle.—The Urban District Council has secured the insertion of a clause in its provisional order empowering the Council to arrange for a supply of electricity from Stockport if it decides against providing an installation of its own.

Ebbw Vale.—The District Council has resolved to apply for powers to supply electricity in the district.

Edinburgh.—At a meeting of the Electric Light Committee of the Edinburgh Town Council last week, it was reported that in the preceding week there had been applications for 4,500 new lamps, or their equivalents, including 14 motors.

Fulham.—We read in the *Municipal Journal* that "there is a certain amount of feeling on the Fulham Vestry against the consulting engineer, Mr. Medhurst. The fact that he has absented himself from the meetings of the Electric Lighting Committee has not escaped the notice of the Vestry. At the last meeting he was present to repeat the explanation which he has already given, viz., that he was absent on the Continent and in Egypt for some weeks, and furthermore, that he was of opinion that he had given personal supervision to enable plans, specifications, and the general scheme of electric lighting to be carried out."

Garston.—The Urban District Council notifies in the *London Gazette* its intention to transfer its provisional order to the Garston and District Electric Supply Company, Limited.

Germany.—Work is about to be commenced on the establishment of a municipal central station in the town of Karlsruhe. The boiler room is to be equipped with six water-tube boilers.

Grays.—Mr. Preece, electrical engineer, has been instructed by the Grays Urban District Council to prepare the necessary plans in order to invite tenders for the installation of the electric light, the Council having received the sanction of the Local Government Board to borrow £12,000 for electric lighting purposes.

Inverness.—Owing to a hitch in the settlement of the electric lighting contracts, the Town Council has rescinded its former resolution accepting the Brush Company's tender, and has reopened the whole question.

Italy.—La Società Elettro-Chemica di Pont St. Martin has secured the right to a concession granted for the utilisation of the water-power of the Dora-Baltea at Pont St. Martin (Piedmont). It is stated that 3,000 H.P. will be available.

Keynsham.—The District Council has accepted the tender of the Keynsham Electric Works for the lighting of the town.

London.—Hampstead.—The Vestry last week received a letter from the clerk of the London County Council, stating that the Council had considered the Vestry's application for a loan of £97,178 for electric lighting purposes, and was only able at present to sanction the borrowing of £90,740, and that, as the Vestry had elected to spread the repayment of the whole of the initial cost of the installation over 42 years, the Council would decline to give its sanction to the raising of any loan to replace any of the plant and machinery which might be necessary during the currency of the loan, and would expect the Vestry to provide for all replacements and renewals required during that period out of a sinking fund or from maintenance accounts.

Newington.—The Vestry has resolved to increase the number of glow lamps for street lighting by over 200 additional points.

Poplar.—A conference of delegates from Whitechapel, Mile End, and Poplar is to be held to consider the course of action to be taken with reference to the Charing Cross and Strand Electric Supply Corporation's Bill now before Parliament.

Whitechapel.—A deputation from the Charing Cross and Strand Electric Supply Corporation waited on the Vestry recently and explained the necessity of carrying the mains for lighting the City through Whitechapel, and the advantage to the Vestry of supply from the Bow station in case of emergency.

The Vestry has resolved to borrow £10,000 from the County Council to carry on the erection of the electricity works, the loan to be repayable in 42 years by equal annual instalments, with interest at the rate of 3½ per cent. per annum, on the understanding that during the currency of the loan renewals shall be paid for out of a sinking fund, and shall constitute a maintenance charge on the undertaking.

East End.—A few weeks ago a deputation from the Vestries of Mile End Old Town and St. George's-in-the-East and the Limehouse District Board of Works waited on the Board of Trade in support of their applications for a provisional order to light their districts by electricity. A reply has now been received that subject to confirmation by Parliament their applications will be granted and that a scheme will be prepared, on the formation of the new borough of Stepney, by which the Whitechapel installation will be extended so as to supply the whole of the area of the new municipality.

Electric Light Failures.—At Marylebone, the Metropolitan Electric Supply Company, Limited, came before Mr. Plowden on Tuesday to answer six adjourned summonses, issued at the instance of the Marylebone Vestry and the Marylebone Board of Guardians for, in the month of December, making default in the supply of electrical energy. Mr. Neill prosecuted, and Mr. Muir defended. When the case was originally heard, Mr. Muir asked, as a test, that the case should be adjourned for three months.

Mr. Neill now stated that during the months of January, February, and March, there had been 14 occasions on which the company had failed in its supply.

Evidence having been given by Mr. T. G. Bacon, electrical inspector to the Vestry, and Mr. R. R. Todd, the company's engineer,

Mr. Plowden said he thought the explanation as to the failures this year exculpated the company. On the original summonses the company would have to pay 5s. for each date (total £1 5s.) with 10 guineas costs.

At Southwark Court before Mr. P. Taylor, the London Electric Supply Corporation, Limited, were summoned on Tuesday, at the instance of the L.C.C., for failing to maintain a proper supply of electric light to various public offices and private premises on various dates in January and February. Mr. Daldy appeared for the Council, and Mr. Bailhache for defendants.

Mr. Bain, the manager, having given evidence,

Mr. Paul Taylor said that not the slightest evidence had been given to show negligence on the part of the company. On the whole evidence he had come to the conclusion that he must dismiss the summonses.

At Greenwich on Tuesday the London Electric Supply Corporation, Limited, London, appeared to seven adjourned summonses at the instance of T. Allen Snaddick, the occupier of the Dover Castle public house, Broadway, Deptford, for making default in supplying electrical energy to the premises. Mr. Lawless was counsel for the prosecution, and Mr C. M. Bailhache defended.

Mr. Bailhache admitted the failure to supply on certain dates.

Mr. Bain, the manager, gave evidence of the difficulties the company had laboured under through the failure of contractors to supply boilers to time, as well as through explosions of tubes, which necessitated the withdrawal from use of five or six boilers. The coal supply had also been a cause of difficulty.

Mr. Kennedy said he would give his decision on May 4th.

Nuneaton and Chilvers Coton.—The Local Government Board recently informed the Parish Council that after considering the Council's application for permission to contract a loan of £16,000 for the purchase of the Nuneaton Electric Company's undertaking, they were not satisfied that the purchase would not involve a charge upon the rates. But if the Council, after further consideration, retained the opinion that the purchase was advisable in the interests of the districts, the Board would not refuse to sanction the loan, provided the Council undertook to consult an expert as to future works, and be guided by his advice. It was decided to inform the Local Government Board that the Council thought it desirable to purchase the undertakings, and would consult an expert.

Oldham.—A gas explosion occurred in an electric conduit on Friday last, blowing up a considerable length of pavement, but injuring no one.

Perth.—Last Friday Sheriff Sym held an inquiry on behalf of the Secretary for Scotland as to the provisional order which had been applied for by the Perth Commissioners for power to borrow £50,000 in connection with the gas works, and £50,000 for the installation of the electric light. The convener of the Electric Light Committee and Mr. Hawtayne gave evidence in favour of the electric lighting application, which was not opposed.

(*Continued on page 707.*)

THE EQUIPMENT OF THE ELECTRICAL ENGINEERS R.E. VOLUNTEER CORPS.

We reproduce herewith photographs taken a few days before sailing, of the first detachment of the above corps, and of its gallant and esteemed commander, Major Crompton, in his regimental khaki uniform, together with a selection from a number of views illustrative of the apparatus taken out to South Africa by the Electrical Volunteers.

Traction Engines.

A good illustration of one of the engines taken out is shown in fig. 3.

Burrell's special single-crank compound engines were the first two to sail; they were arranged to be of a specially light build, weighing only 8—9 tons, whilst indicating 18 H.P.

One of the special features of these engines was the arrangement of the two cylinders, one above the other, the two piston rods working on a single cross-head, to the centre of which the connecting rod was attached.

The engines were capable of drawing loads of about 12 tons each, and it was found that they could travel on an average road for about 6 miles with the water carried on the engine.

For stationary work the water consumption worked out at about 32 lbs. per hour per E.H.P. developed, which is not a bad result to obtain from an engine of this type, though it was anticipated that after a little experience in handling the engines, the water consumption would go down to about 28 lbs. per hour.

The last engine shipped of the same make was arranged for partial condensation, with a view of further economising the water.

To enable the engine to run for longer periods, one wagon was used exclusively for carrying additional water and fuel.

As regards the coal consumption, it was found that under ordinary conditions of working between 6 and 8 cwt. of coal was consumed per 8 hours' day.

It was found advisable to fit special spring arrangements to the front of the engines, to minimise the jolts transmitted to the dynamo—which was fixed on the bracket shown on the front of the engine, and was belt-driven off one of the engine pulleys.

The dynamos were of the multipolar semi-enclosed type, manufactured by Messrs. Laurence, Scott & Co., and Messrs. Bruce Peebles, and were designed for 110 volts, 80—100 amperes, 750 revolutions per minute.

Finally, the engines, when completed, were entirely roofed over, and by means of waterproof covers dropped from the top (not shown in illustration) they were completely covered in.

Major Crompton.

Projectors.

These have had to be specially designed, and with the exception of the barrel, almost everything is novel. The gun-metal bases revolve in ball-run turn-tables, in the centre of which a degree circle is fixed, with a movable pointer to facilitate synchronising the projectors at a distance.

In this way, if a number of projectors were in position some distance apart, and it was necessary to move their beams simultaneously through the same angle, they would all receive instructions to set their pointers to the same angle on the dial, so that one command by telephone would be correct for them all. The projectors are fitted on special steel trails, similar to gun-carriages, but fitted with springs. These trails are mounted on wheels from the Royal Arsenal, which ensures their being interchangeable with other wheels in the field.

The projectors may be detached from their carriages, and can then be used as stationary projectors on the ground, their four feet being each separately adjustable for height.

The mirrors, glasses, and divergers are mounted in aluminium; whilst the Coles reflectors are of deposited copper faced with silver, with a thin coat of palladium to prevent tarnishing.

It has been found necessary to entirely remodel the lamp mechanism, the pattern service lamp being far too heavy and clumsy; also, it was feared that the usual arc-striking arrangement would be hammered to pieces by the vibration of the moving carbon when the lamp is travelling about. The new lamp is arranged to lock the movable carbon holder in position, after the arc is struck, the feeding movement being carried out by the shunt coil acting on the other carbon.

As a drop of 52 volts can be allowed between the dynamo and the arc, the searchlights may be situated a mile or more away from each traction engine.

In working the projectors the elevating motion is actuated by means of a worm, and is consequently slow in operation; on the other hand, the horizontal motion, which has to be worked quickly for signalling purposes, is pulled round by hand.

Accuracy is naturally not of so great importance in the horizontal as in the vertical motions.

The projectors on their trails can be drawn either by traction engines, by mules, or by hand, and for this latter purpose drag hooks have been arranged on the end of the axle, so that they can be hauled along like an ordinary gun. A draw hook is fixed for pulling a second projector along, and when travelling the projector is usually attached to its limber in front.

A powerful screw brake is fitted, which can be worked from the hindermost end when travelling.

Provision is made for attaching to the projector trail an ammeter, voltmeter, and main switch, the latter being normally fixed to the trail. Provision has, however, been made for fixing them at either end, the ammeter and voltmeter being suspended, whilst holes have been drilled for attaching the main switch. The projector carriages were made by Messrs. Thorneycroft, whilst the design and the manufacture of the projectors and projector lamps was undertaken by Messrs. Crompton & Co.

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Fig. 4 shows very clearly the projector mounted on its trail. The instruments are also shown hung in position, whilst in the centre is Captain Lloyd, R.E, with his hand on the main switch.

A Group of the Electrical Engineers Volunteer Corps, Sailed for South Africa March 16th.

On the right hand side is shown the limber, and on the top the adjustable resistance, which is referred to elsewhere.

Limbers.

The limbers consisted of wooden boxes lined with steel, whilst the underframes were built up of angle iron.

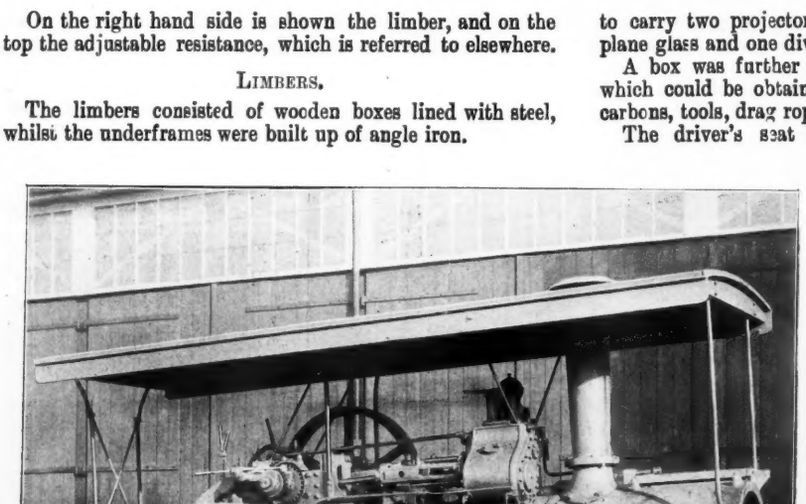


Fig. 3.—Burrell's Traction Engine.

They were mounted on springs, the axles and wheels being made interchangeable with those of the projector carriage. They were arranged for draught with mules or traction engine, by using a pole, or for being pulled by hand with ropes. Behind, a flap door was fitted, by lowering which the inside of the box, thoroughly lined with felt, was exposed. The inside of this box was fitted up with shelves, and arranged to carry two projector lamps, two mounted mirrors, one plane glass and one diverger.

A box was further fitted underneath the seat, access to which could be obtained by lifting the seat, and in which carbons, tools, drag ropes, ammeter and voltmeter were kept.

The driver's seat was arranged to accommodate two persons, and from it a screw brake could be brought into operation.

On the roof itself a variable resistance in its own box was carried, and this resistance could be worked either in this position or it could be taken down and used on the ground.

In passing, attention might be drawn to the extremely suitable design of a resistance of this description for rough work. It consisted of short lengths of solid wire fixed rigidly between asbestos clamps, thus running little risk of short circuiting when the wire became heated and expanded—a trouble frequently met with when coils of wire are used.

The limbers were made by the Gloucester Wagon Company.

Portable Cable Drums.

The cable carriages were arranged to carry three drums on each, the centre drum being somewhat larger than the other two.

About 200 yards of cable could be carried on each drum, the cable being capable of transmitting about 100 amperes. It was chiefly concentric, with the outer conductor bare, and braided to prevent its unwinding should one section become damaged.

All fittings, such as ammeter, switch, &c., contrary to the usual practice, would be arranged on the outer or earthed wire, which would enable one to do any coupling up without fear of shock.

Each drum was prevented from turning at will by means of a brake, whilst the cable was wound up by hand after use.

The wheels and axles were here again interchangeable with those used for the projectors.

The drums could be pulled in either direction, either by means of a traction engine or by hand; when drawn by hand ash handles could be fitted in.

In fig. 5 is shown the portable cable drum, with an ash handle in position, ready for being hauled by hand.

Telephones.

To facilitate communication 20 cycles have been taken out, some with 8-inch, others with 9-inch cranks. Six of these cycles were fitted with spindles over the back wheel, to which were attached two light cable drums, each holding nearly 2 miles of fine bare copper wire.

A cyclist can pay this wire out whilst riding along as fast as he can go, say, from 5 to 15 miles per hour.

Small brakes without much friction were fitted on these drums to keep the wire from overrunning.

The wire was bare, whilst the earth was used as the return circuit, and it was found that even on wet ground one could telephone up to 3 or 4 miles with the wire trodden in the ground, and even broken.

Fig. 4.—Projector Mounted on Trail, with Limber.

To pick up the wire a handle was attached to the drum, and the cyclist wheeled the bicycle forward with one hand and wound with the other, the wire being led over a guide on the handle bar and thence to the drum. It was found that the wire could be picked up in this way as fast as the cyclist could walk, say, 4 miles per hour.

In the event of the wire being badly damaged it would be left on the ground, as, being light, any quantity of spare could be carried.

The telephones themselves were carried on the back of the cyclist, and were of the Swedish cavalry pattern; they could either be used for speaking purposes or the signal might consist of the "buzzer" being used on a high resistance or leaky surface.

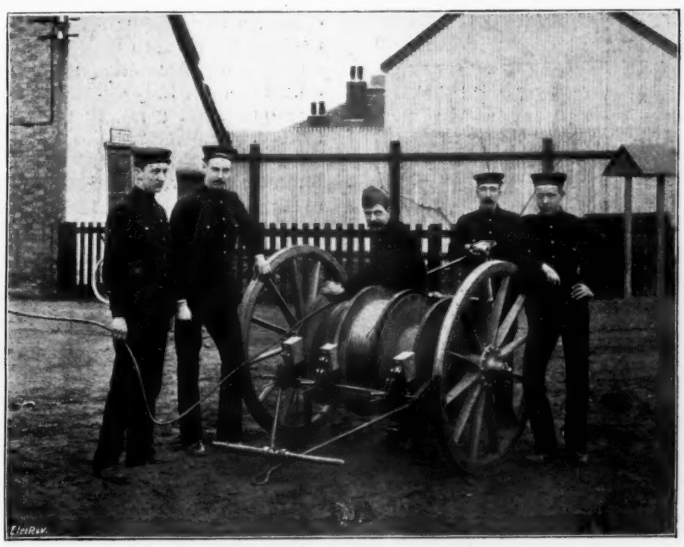


Fig. 5.—Portable Cable Drum.

These instruments are fitted with a third terminal through a condenser, which enables one to tap an enemy's wire and hear all that is going on by just laying a wire from this third terminal across the telephone wire, and without in any way interrupting the conversation.

In the same way a commanding officer can listen to any instructions being given by his subordinates.

In fig. 6 is seen a sapper in the act of using his field telephone. The drums mounted over the back wheel of the cycle are clearly seen, and from this picture it will be easily understood how simple it is to lay the telephone wires.

As many of our readers have, doubtless, friends in this corps at the front, we might point out that Mr. F. Spalding, photographer, of Chelmsford, has taken a complete series, including photos of nearly all the individual members of the corps.

GAS OR ELECTRICITY FOR HEATING, LIGHTING AND POWER.

Under this title there appears in *Cassier's Magazine* this month a short article by Mr. A. D. Adams. It is a subject upon which volumes might be written without fear of exhausting the aspects from which it might be viewed, but Mr. Adams, in four pages, arrives at these conclusions:—

1. "The great bulk of the heating derived from public supply should be effected by gas.

2. "Power in small units is best distributed electrically, but for large units gas is more suitable.

3. "For the purposes of illumination, electric energy is much superior to gas from every point of view, and may be expected to generally supersede it for that purpose."

The facts presented in the paper which, in the author's opinion, warrant these conclusions, are briefly as follows:—

The efficiency of a boiler plant is taken at 80 per cent., that of the steam engine at 15 per cent., and that of the dynamo at 90 per cent., the combined efficiency being $80 \times 15 \times 90$ or 10·8 per cent. It is then pointed out that water gas has a calorific value of 750 heat units, and contains about 75 per cent. of the heat energy of the fuels (coal and petroleum) used in its production, and therefore it appears that seven times more fuel ($75 \div 10{\cdot}8$) is required to deliver a unit of energy in the form of electricity than would be the case if gas were used. This seems to give gas so overwhelming a start that electricity "must present some decided gain in application to warrant its extended use." The author then characterises electric heaters as being among the very few devices that have a perfect efficiency, but states that owing to the very

low efficiency found for the production of electric energy, its extended application to general heating is prohibited. But why so much circumlocution? It is quite evident that even 100 per cent. efficiency for a heater could not make 10·8 per cent. heat energy any greater, but as a matter of fact no such heater has as yet been discovered applicable to any purpose other than heating air, and surely the circumstances in which one would be driven to burn coal under a boiler or in a gas producer, and turn the energy liberated into mechanical and electrical energy merely for the purpose of frittering the electrical energy away in a resistance producing heat, must be very few and far between. For any other purposes except air heating the efficiency of the electric heater is lamentably low, and from the point of view of cost, no one would heat by electricity unless he got his energy at a price for which it would be absolutely impossible to supply it at a profit. There can be no doubt that for certain purposes, such as car heating, where the car is driven by electricity, the immense advantage of heating without combustion at the point where the heat is given off is so overwhelming that it quite outweighs the extra cost. On all electric roads the heating of the carriages by electricity should be compulsory.

Similar arguments are advanced with regard to the production of power. It is stated that while steam engines have an absolute efficiency of 15 per cent. and gas engines of 25 per cent., the electric motor turns 90 per cent. of the energy supplied to it into work. This is quite true, but you do not pick up electricity like lumps of coal—the comparison is not made from a common basis. However, it is pointed out that even with 90 per cent. efficiency the production of power by electricity is sadly below that produced by a gas engine, hence conclusion No. 2 is arrived at, and the electric motor, except for small powers, makes an inglorious exit.

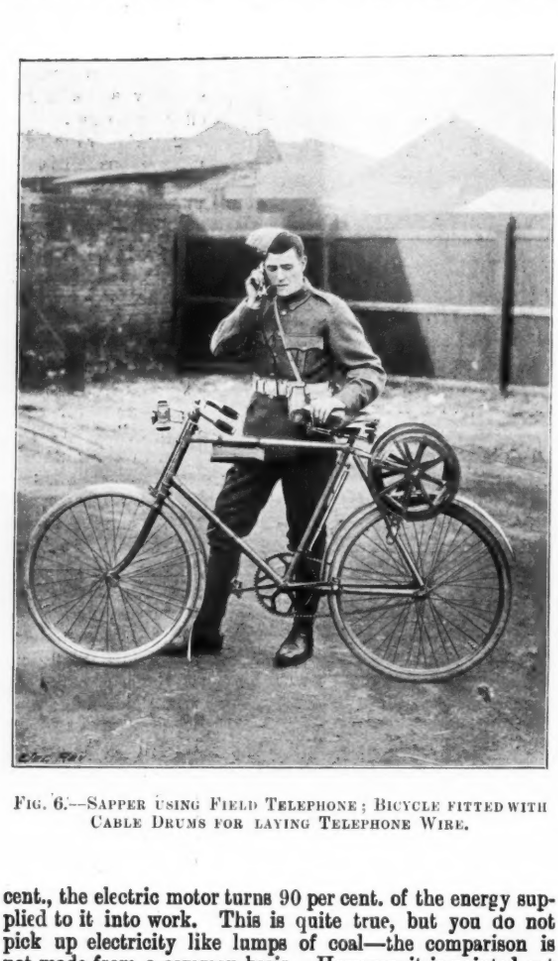


Fig. 6.—Sapper using Field Telephone; Bicycle fitted with Cable Drums for laying Telephone Wire.

The question of illumination by electricity and gas is dealt with summarily. A gas burner consuming 5 cubic feet per hour of gas having a calorific value of 700 Th.U. is assumed to yield 18 C.P., whereas the electric arc lamp is credited with only 1 candle per watt. The gas flame, therefore, consumes $\frac{700 \times 5}{18} = 194$ heat units per candle, and the arc lamp $1 \times 3{\cdot}4 = 3{\cdot}4$ heat units per candle. Thus the arc lamp is $\frac{194}{3{\cdot}4}$, or 57 times better than the gas flame on the score of producing light.

It is hardly necessary to point out to our readers that these figures do not accurately, or even fairly, state the case. Most buyers would very soon return an arc lamp that did not give more than 1 candle per watt, and, on the contrary, the gas burner that would yield 18 candles per 5 cubic feet of gas burnt per hour would rapidly make the fortune of its inventor. Again, 700 Th.U. per cubic foot is a high figure for the thermal value of a cubic foot of ordinary town gas, and while in the future we may have a 20-C.P. carburetted water-gas supplied in the place of the present mixture, we have not arrived there yet. The subject of the relative cost of light production by electricity and gas in various forms has been dealt with in our columns during the past few weeks, and we need not, therefore, enlarge upon it here.

It is dangerous to generalise from insufficient data, and while on broad—very broad—principles we can find no fault with the conclusions arrived at in the article in question, there exist so endless a variety of conditions under which power may be produced and utilised, that the question, for instance, of the limiting conditions of the economy of using small electric motors is one which cannot possibly be answered in a few words.

This latter subject in particular is of the greatest importance, for there can be no doubt that the advantage of subdivision of power in factories is only just beginning to be realised, and has an immense future.

Manufacturers' Sizes.—We have heard a good deal of late from the manufacturers' side about the hard and fast specifications of engineers and the expense of working up to them because standard patterns could not be used. We have believed, and still believe, that there is a good deal to be said on this point. At the same time, the other side claims attention. We are informed by an engineer who was of opinion that manufacturers' patterns should, if possible, be made use of, that he recently prepared specifications with these points in view. The specifications were open, and left makers free to state their own dimensions. There was nothing in the specification that was not a regular article of manufacture in the trade. Many firms were invited to the feast and they all with one accord began to make excuse. Some averred that the leading dimensions which were suggested, but specially stated not to be imperative, were absolutely unusual. They coincided, as a matter of fact, with catalogue sizes. Others stated that they were too large for them to undertake, though they had previously undertaken larger work. One firm went so far as to ask for a hard and fast fully dimensioned drawing, when they would then quote, and generally the replies were not at all satisfactory. Our informant is of opinion that contractors are often not prepared to submit prices to their own designs, because they have no decent designs, and rely on engineers to furnish them. He is naturally disappointed at the results, and surprised at the attitude of the majority of contractors.

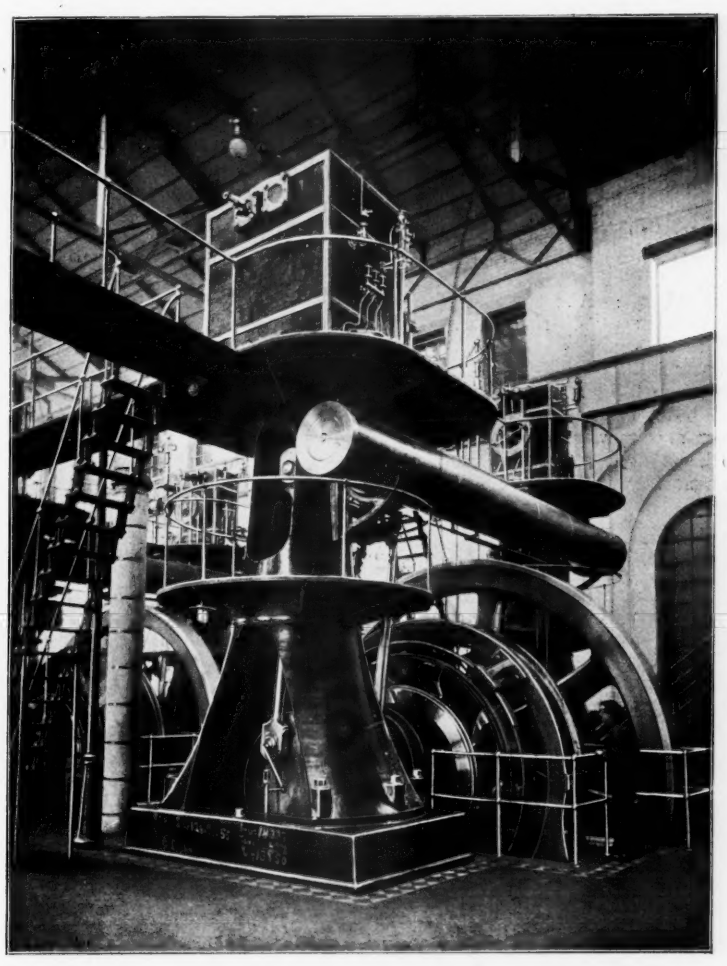
Automobiles for the U.S. Army.—One of the innovations in military transportation which was brought about and developed largely through the American war with Spain is the use of the automobile. The signal corps of the American army has recently, says a New York exchange, been supplied with electric automobile wagons for use in the Philippines. These wagons are of two kinds, one to carry the instruments and material and the other to carry the *personnel*. The first is built like a covered ambulance, with rubber-tired wheels, and contains a storage battery capable of running the vehicle for 30 hours on one charge when carrying 1,500 lbs. of load. There are two 3½-H.P. motors, one in each rear wheel. The maximum speed is about 10 miles an hour. The other wagon is constructed like a high cart, and is in other respects similar to the first. Both wagons are fitted with electric side lights, and the first also has electric lights in the interior. Other military applications of the automobile have been considered by the military world, but this is the first actual introduction.

DUBLIN ELECTRIC TRAMWAYS.

(*Continued from page* 663.)

The illustration of a complete generating set which we give below shows clearly the general arrangement of the engines. The large trunk seen below the upper platform is a multi-tubular reheater receiver, heated with live steam. There are two eccentrics for each cylinder; the valves are double-ported, to shorten the travel, and the exhaust chambers are separate from the cylinders, to reduce condensation. The crankpins and discs are forced in place with hydraulic pressure; the piston rods are secured to the crossheads with screw-threads and lock-nuts, so as to enable the clearance at both ends of the cylinder to be adjusted, and the cross-head slides are bored concentric with the cylinders.

The dynamos, which were made by the G.E. Co., to Mr. Parshall's designs, have 10 poles, and are rated at 550 KW. at 550 volts when running at 90 r.p.m. The fields are of cast-steel, so arranged that any pole can be removed without disturbing any other part of the machine. The armature is built up on a cast-iron spider of soft iron stampings 0·014 inch thick, with 300 slots, each 2 inches deep × 0·525 inch wide. The core is 96 inches diameter × 20·5 in. long, including ventilating ducts, the net iron length being 14·85 inches. At the normal speed of 90 revolutions per minute, it follows that the peripheral speed is only 2,260 feet per minute.



550-KW. Generating Set.

The commutator is 86 inches diameter, with an active length of 8·875 inches, and is built on a spider secured to the armature spider, so that the whole is self-contained and independent of the shaft. There are 900 commutator segments, of hard drawn copper, with a radial depth of 2 inches; groups of these can be removed without disturbing the remainder. The brushes are arranged in sets of five, each $\frac{3}{4}$ inch × $1\frac{1}{4}$ inch, with a current density in the contact surface of 42·8 amperes per square inch at full load.

The armature is parallel-wound, with six conductors per slot, insulated from the core with paper and mica to a thickness of 0·1 inch; the resistance from brush to brush is 0·0109ω at 20° C., and the current density in the armature at full load is 1,000 amperes per square inch.

As for the magnetic data, the pole arc is 23·6 inches in length, the ratio of pole to pitch being 0·783; the air gap is 0·375 inch deep between iron. The induction density in the armature at full load is 67,000 lines of force per square inch, and in the teeth 129,400; the density in the pole face is 48,000, in the magnet core 88,400, and in the yoke 78,500 lines per square inch. The armature ampere-turns per pole are 9,000; the resistance of the shunt winding is 57ω, and of the series winding 0·00405ω.

The machine is tested with 5,000 volts alternating for three minutes on completion, and is able to stand 1,750 amperes thrown on or off, without injurious sparking.

The results of tests made on one of these machines show a remarkably well-sustained efficiency over wide ranges of load:—

At $1\frac{1}{4}$	full load,	commercial efficiency	94·4	per cent.
" 1	"	"	94·5	"
" $\frac{3}{4}$	"	"	94·5	"
" $\frac{1}{2}$	"	"	94·0	"
" $\frac{1}{4}$	"	"	91·0	"

This is a specially valuable feature in a machine destined to work on a load which is continually varying over a wide range.

The total iron loss at full load is 11,000 watts; the temperature rise after an 8 hours' run at 550 KW. was found to be 26° C. on the surface of the armature.

The weight of the armature alone is 37,630 lbs., while the whole machine weighs 83,000 lbs. The arrangement of the generator between the two engines is well seen in our view of a single set, while the valve gear is shown to better advantage in the separate views of the high and low pressure cylinders; the speed governor, which is seen mounted near the latter, is connected with the high pressure gear by a shaft extending between the two engines, and the emergency governor is fixed on the high pressure cylinder.

A remarkable feature of the engines is their silence; accustomed as we were to the clickety-clack of a roomfull of trip-gear engines, it was hard to realise that five 750-H.P. engines of this type were at work. The valve gear was practically inaudible, the deeper sounds inseparable from the working of large low-speed engines being alone appreciable. The whole of the plant has been designed so as to be able to readily cope with the heavy overloads which at times are unavoidable in tramway working.

A singular occurrence of this nature took place not long ago; a large number of cars had come to rest close together on account of a block of some duration, and upon its removal, they all endeavoured to start at once, throwing an extraordinary load on the station! In fact, it became necessary to hold the circuit breakers up by hand in order to get over the difficulty, it being regarded by the company of the utmost importance to keep the line alive, no matter what else betide.

The switchboard consists of 31 panels, mounted on an elevated gallery. There are six generator panels, each fitted

and the arc lamp $1 \times 34 = 34$ heat units per candle.

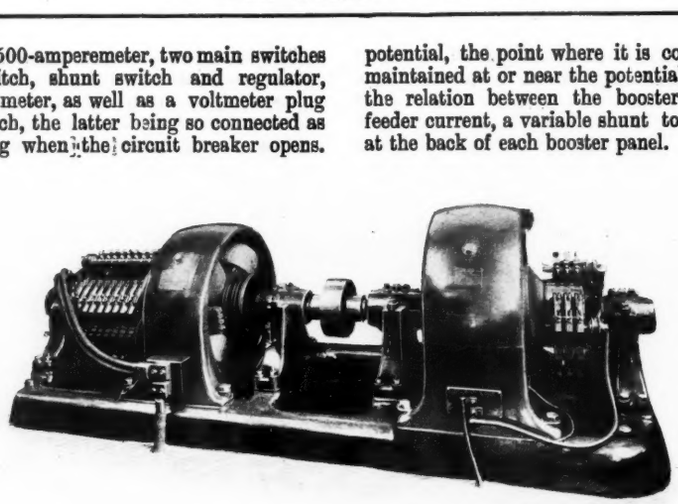
world, but this is the first actual introduction.

with a circuit breaker, 1,500-amperemeter, two main switches and one equaliser switch, shunt switch and regulator, and Thomson watt-hour meter, as well as a voltmeter plug and station lighting switch, the latter being so connected as to maintain the lighting when the circuit breaker opens. The station panel is fitted with a total-output ammeter reading to 8,000 amperes, a bus bar voltmeter, and a machine voltmeter.

There are 18 feeder panels, each fitted with a 1,000-amperemeter, circuit breaker and switch; these are arranged in groups to correspond with the negative booster panels, of which there are four. Each bears a 200-amperemeter for the motor, a 1,500 amperemeter in circuit with the group of positive feeders, and a similar one in the negative feeder, a booster voltmeter reading from 0 to 50 volts, motor starting switches and shunt regulator, and feeder switches. The negative feeder is controlled by a single switch, while the positive feeders are connected with a set of three switches, by means of which they can be joined direct to the positive bus bars, or can be put in series with the field of the booster.

The arrangement is as follows:—As many of the feeders running out to points in the same district as are found necessary are connected to the field of one booster, so that the excitation of the latter is proportional to the current going out to the trolley wire; a single negative or return feeder, in series with the booster armature, is carried to the rails at the electrical "centre of gravity," so to speak, of the district above mentioned, so that it provides a path for as much of the return current from the positive feeders as is found necessary to conform with the Board of Trade rules for the earth return.

The booster armature introduces an E.M.F. into the return feeder approximately equal to the drop due to the resistance of the latter, so that while the end of the feeder where it enters the engine room is considerably below earth potential, the point where it is connected with the rails is maintained at or near the potential of the earth. To adjust the relation between the booster E.M.F. and the positive feeder current, a variable shunt to the booster field is fixed at the back of each booster panel.

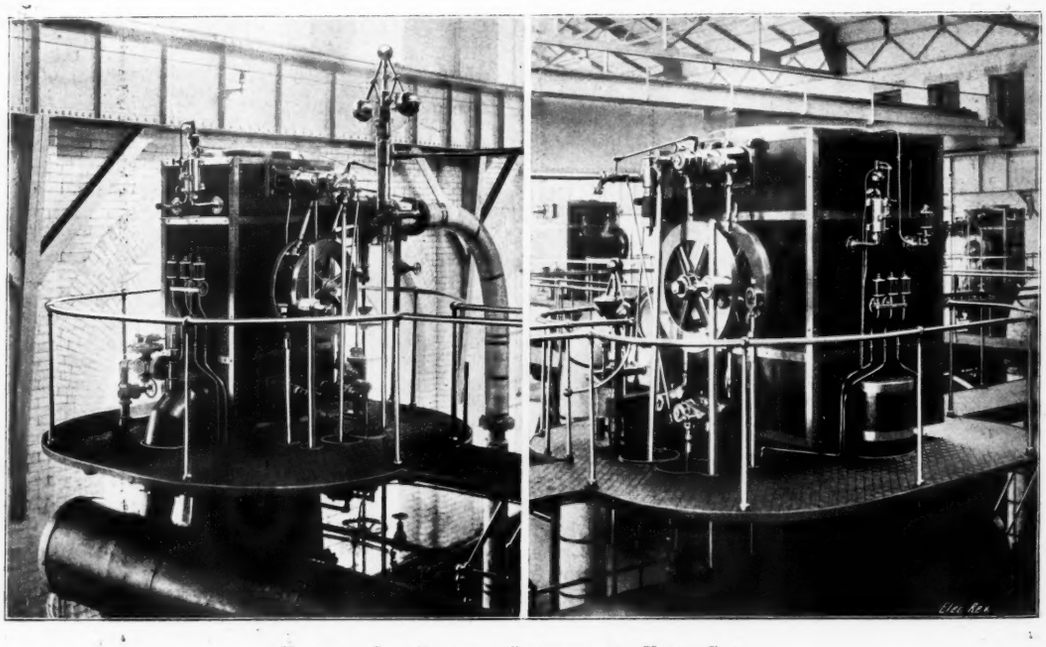


1,000-Ampere Booster Set.

The Board of Trade panel is equipped with the usual recording instruments, by Messrs. Elliott Bros., and a station power panel is provided, fitted with a Thomson meter, three main lighting switches, and switches and circuit breaker for the motor circuits.

The panels are composed of black enamelled and paraffined slate, 2 inches thick, carried on angle-iron supports. The main bus bars are built of copper plates 5 inches wide $\times \frac{1}{4}$ inch thick, with air spaces of $\frac{1}{4}$ inch between them to provide for ventilation, the number of plates varying with the current to be carried at any given section. Magnetic blow-out lightning arresters, of the standard B.T.H. type, are connected with the feeders, each in series with a non-inductive resistance of 100 ω, and the feeder is led away through a solenoid or "kicking coil" of stout bare copper rod. All the conductors from the switchboard are of bare copper strip carried on insulators from the switchboard floor to the basement, where they are joined to insulated cables.

Three of the boosters are of 15 KW., and one of 24 KW. capacity. We give a view of the last-mentioned machine, which is remarkable for its enormous commutator, with 10 carbon brushes in four sets, capable of carrying 1,000 amperes. The maximum boost is in each case 30 volts, and the overall efficiency 81 per cent.



High and Low Pressure Cylinders and Valve Gear.

The station lighting is carried out chiefly with enclosed arc lamps, burning five in series on a 500-volt circuit, taking 5 amperes, and running for 100 hours before re-trimming. Ten of these lamps light the engine room, five the boiler house, and five the shops. The rest of the station is lighted with 250-volt glow lamps run two in series; the wiring

lines per square inch. The armature ampere-turns per pole

elevated gallery. There are six generator pulleys, each fitted

is protected by the Interior Conduit Company's pipes. Silvertown vulcanized rubber insulated cables are used for this purpose. There are in all 226 16-c.p. lamps, and 12 of 32 c.p.

Outside the station, the mains are drawn into cement-lined sheet iron pipes, 3 inches diameter inside and 4½ inches outside; the iron is No. 26 B.W.G. These run from the station to roomy manholes situated in various parts of the city and suburbs; the number and size of the manholes are given in the following table :—

Number.	Length.	Width.	Depth.	Number of ducts.
10	10 feet.	10 feet.	6½ feet.	24—40
6	8 „	8 „	6½ „	15—24
5	6 „	6 „	6½ „	9—14
154	4 „	4 „	6½ „	5—8
201	3⅔ „	2⅔ „	2½ „	1—4

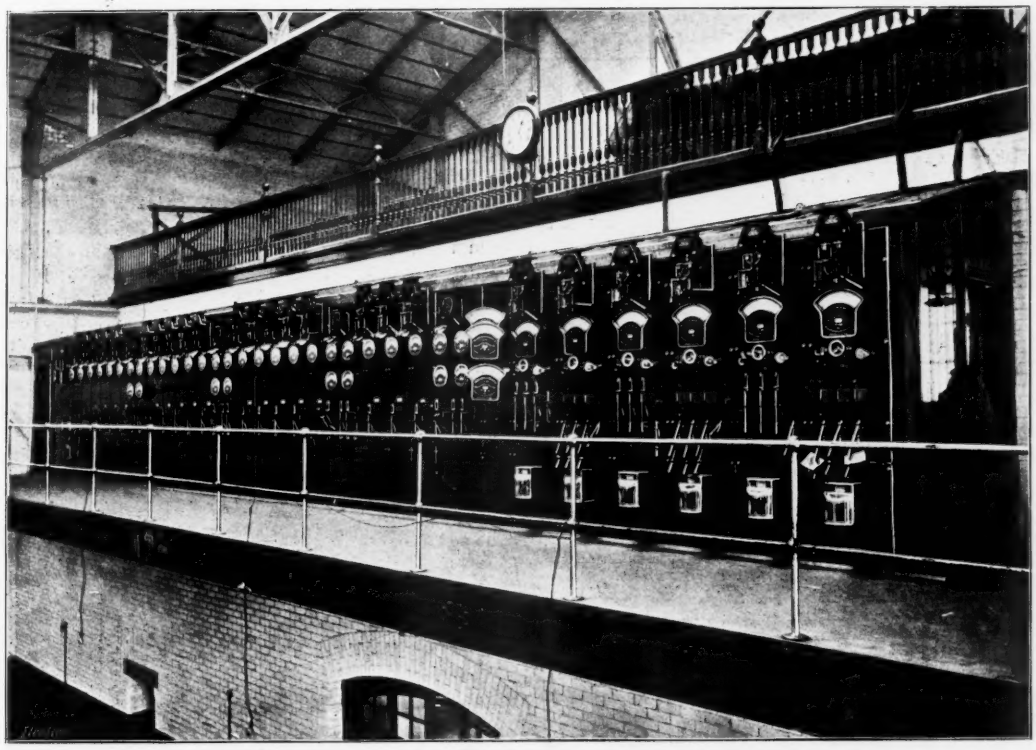
The last of these sizes is used as a service box.

In every case the flooring consists of a concrete bed 6 inches thick, upon which are built brick walls 9 inches thick, with a roof of tram rails and brick. They are all drained to the

length; and three of 1·076 square inch, made up of two cables in parallel, and from 2,253 to 2,536 yards long. Combined test and telephone cables are also laid to the various termini, the latter being tapped at various places *en route*.

Before passing to the lines and rolling stock, we return for a moment to refer to the important changes and extensions now in progress. As our readers are aware, the Dublin-Dalkey line is worked by means of three-phase current generated at Ballsbridge, transmitted at high pressure, transformed down and converted to direct current in sub-stations at Blackrock and Dalkey.

It has been considered advisable to abolish the station at Ballsbridge, and, instead, to transmit the power direct from Ringsend. At the same time the generating station at Clontarf, already superseded by Ringsend, is to become a three-phase sub-station in order to supply power to the long and distant branch running out to Howth. The positions of these places may be readily recognised by means of the map of Dublin and its environs which we publish herewith



Main Switchboard at Ringsend.

sewers, and are fitted with perforated iron covers, except on the Clontarf route, where they are water-tight. This is due to the fact that this line is subject to flooding by sea-water —indeed, there is often 2 to 3 feet of water on the track, through which the motors plough their way serenely! About 400,000 yards of duct have been laid in all.

The cables, which, as well as the conduits, were made and laid by the National Cable and Conduit Company, are of the lead-covered paper-insulated type, and are specified to stand the application of 1,000 volts alternating between the conductor and the sheathing or earth for a period of 15 minutes without injury; they must also carry double the normal current for 12 hours without deterioration. The contractors have agreed to maintain the cables for 10 years, and guarantee the same from defects in construction or laying, and from damage caused by electrolysis.

The feeders vary in cross-section, according to their duty, from 0·75 square inch to 0·2 square inch; they are cut into half-mile sections by disconnecting boxes. The distributors vary from 0·3 square inch to 0·15 square inch, and the return feeders are as follows:—One of 2·25 square inches, made up of three cables in parallel, and 3,490 yards in

and which gives a good idea of the extraordinary network formed by the tramways, as well as of the facilities provided for traffic with the suburbs in all directions.

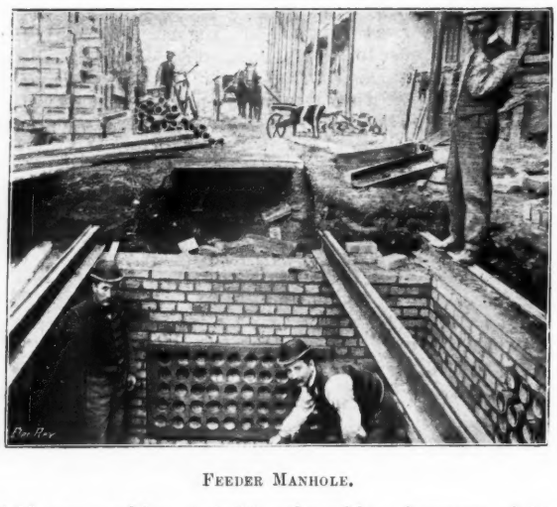
The reasons why Mr. Parshall decided upon the use of three-phase transmission on the Dalkey line were fully set forth in his paper before the Institution of Civil Engineers, to which we have already referred—the chief point aimed at being compliance with the Board of Trade rules for the drop in the earth return. The considerations which led him to convert the alternating to direct current for actuating the motors on the cars are also detailed in the discussion which followed the paper; we need not, therefore, go into the question here.

The apparatus to be installed in the Ringsend power station for the three-phase transmission consists of one 500-kw. three-phase generator, coupled to an Allis engine similar to those already at work, and two rotary converters, each of 250 kw. output. By this simple arrangement the necessity of duplicating the three-phase generating plant is avoided; for the rotary converters, taking power from the direct current generators, and delivering it to the three-phase circuits, provide the needful reserve, and at the

where it enters the engine room is considerably below earth

with 250-volt glow lamps run two in series; the wiring

same time link together the two systems, so that in case of need it would be possible for the three-phase plant to help the direct current side. The generator is of the revolving



Feeder Manhole.

field type, working at 2,500 volts, with a frequency of 25 periods per second; the field is to be excited from the 500-volt mains. The efficiency of the generator is specified to be not less than 95 per cent. at full load, and 93 per cent. at half load, with a rise of temperature not exceeding 40° C. in any part after 12 hours' run at full load.

The rotary converters are designed to have overall efficiencies of not less than 93 per cent. at full load, 92¼ per cent. at ¾ load, and 90 per cent. at ½ load, while when generating direct current they are to be over-compounded to 550 volts by means of reaction coils in the alternating side; it is further provided that they shall maintain their speed within 5 per cent. of the normal at all loads between no load and full load, whilst the phase of current and E.M.F. on the alternating side is varied by 30°. The current density at full load in the armature winding will be 3,500 amperes per square inch, reckoned as a direct current generator; but owing to the confluence of the direct and alternating currents in the armatures of these converters, the actual current density will be far below this value.

The pressure between the collecting rings will be 312 volts, when a pressure of 500 volts is applied to the commutator; transformers are therefore provided, seven in number, for the purpose of raising the pressure to 2,500 volts, and *vice versâ*. These are of the single-phase type, connected in two sets delta-fashion, with one spare. The drop in voltage is specified to be within 1¼ per cent. at the full load of 100 KW., with an efficiency of

97	per cent. at	100 KW.
97	„ „	75 „
96	„ „	50 „
94	„ „	25 „

and an open circuit loss of not more than 1·6 KW. The transformers are oil-cooled, and are to be tested to 7,500 volts for five minutes between the primary winding and the frame, as well as between the primary and secondary windings.

The additional switchboard consists of one generator panel, two converter, one instrument, two transformer, and five H.T. feeder panels, all of marble 2 inches thick, and polished on both sides. The generator panel is equipped with a triple-pole double-break switch for 200 amperes at 3,000 volts, three A.C. ammeters with transformers, D.C. field ammeter, switch, and rheostat, A.C. voltmeter and transformer, and voltmeter plug. The converter panels each carry two single-pole switches for 600 amperes at 500 volts, and equaliser switch, D.C. 750-amperemeter, field ammeter, switch, and rheostat, magnetic cut-out, starting switch and resistance, and Thomson watt-hour meter. Each of the

Map of the Dublin Electric Tramways.

Based on the Ordnance Survey, by permission of the Controller of Her Majesty's Stationery Office.
Generating stations are represented by circles; sub-stations by squares.

transformer panels bears a triple-pole double break switch for 100 amperes at 3,000 volts; rheostat for final adjustment of field in synchronising; three A.C. ammeters and transformers, one voltmeter with three transformers and voltmeter plug. The feeder panels are fitted with triple-pole switch, A.C. ammeter and transformer. The instrument panel carries one large swivel voltmeter with double scale for synchronising, bus bar swivel voltmeter, three main ammeters and transformers, indicating and integrating wattmeters, instrument transformers and voltmeter plugs.

The cables connecting the switchboards with the generators, &c., are to be insulated with vulcanized rubber, and tested to 10,000 volts alternating for the high-pressure side, 1,500 volts for the low pressure side.

The high pressure feeders to Blackrock and Clontarf are to be of the three-core type, paper insulated, and lead-covered, tested with 10,000 volts alternating after 24 hours immersion in water, and 5,000 volts after laying, applied between any two cores or core and sheath. The 500-volt distributors are to be similarly tested with 2,500 and 2,000 volts alternating, and the whole of the cables are to be guaranteed for 10 years.

(*To be concluded.*)

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 698.)

River Shannon.—The City Council of North Tipperary has rescinded its resolution dealing with the Shannon Water and Electric Power Bill, and has adopted a resolution approving of the project, which it regards as "of material advantage in developing the industrial and commercial resources of the South of Ireland."

Russia.—La Compagnie Centrale d'Electricité de Moscow has secured a contract for the establishment and equipment of a central electric lighting and power station, and a system of electric tramways in the town of Tsaritsyne.

Sandown.—A conference of the Sandown and Shanklin District Councils with reference to a scheme for lighting the two towns with electricity, submitted by Edmundson's Electricity Corporation, was held at Sandown some time ago, at which the scheme was thoroughly discussed.

Sleaford.—The report of Mr. B. Smith, the electrical expert, called in by the Council to advise as to the cost of the proposed electrical installation at Sleaford, gave the amount as £4,764. He offered to prepare plans and specifications, and obtain the necessary tenders for 3 per cent. on the total cost, and, if carried out, a further 2 per cent, making a total of 5 per cent. on cost. Mr. Smith's estimate was accepted, and it was decided to engage him on the terms stated to arrange for the speedy carrying out of the work.

South Bank.—The District Council has entered into negotiations with Messrs. Bolckow, Vaughan & Co. with a view to obtaining a supply of electricity from that company.

Weston-super-Mare. — The District Council has instructed Mr. Hawtayne to report on the plans and specifications of the works being carried out by the Electric Supply Company.

Woking.—The District Council has formally approved the Electric Supply Company's provisional order.

ELECTRIC TRACTION NOTES.

Cardiff.—A special meeting of the Town Council was held last week to consider the question of a combined station for lighting and electrical traction, or a separate and distinct station on its own site for tramway traction purposes. The Tramway Committee, after visiting several towns, recommended that the generating station for tramway traction purposes should be separate and distinct from the electric lighting undertaking.

Alderman Carey moved that the Council adopt a combined station. He stated that Bolton, Blackburn, Blackpool, Bradford, Halifax, Liverpool, Plymouth, Southampton, Wolverhampton, Carlisle, Manchester, Salford, Aberdeen, Doncaster, and, in fact, nearly all the municipalities in the country where they considered this question had favoured combined stations. On the other hand, Glasgow, Huddersfield, Hull, Leeds, Sheffield, Nottingham, and Portsmouth were in favour of separate stations. He contended that whatever could be done by the Tramway Committee in Cardiff the Lighting Committee could most successfully carry out. If the Corporation went in for a separate station they must have extra land, extra buildings, and an additional staff, whereas the present lighting station, with certain alterations, could run a large portion of the trams in Cardiff. It was said to be necessary that the traction station should be near the centre of the town. The Tramway Committee had scheduled land or stations at Roath, Portmanmoor Road, Cathays, and Clare Road, which were most of them as far from the centre of the town as the lighting station. The Lighting Committee had expended £85,000 upon their station, and had power to lay out an additional £12,000. The capacity of the station at present was 60,000 units per annum. At present they supplied 30,000 units, and as new applications for 10,000 a year were coming in the committee would have to look out for another station during the next few years. They supplied the public lamps at £18 per annum, which worked out at 1·7d. per unit, although the cost in generating was 2·16d. per unit. They lost, therefore, ½d. per unit, which amounted to over £200 per annum. He did not believe in getting every penny possible out of the other departments of the Corporation, which would practically be robbing Peter to pay Paul. In Bristol the charge per lamp was £32; in London and Edinburgh it was £26. The cost of generating had been reduced from 3 1d. per unit in 1895 to 2·16d. per unit in 1898. If the Corporation had not taken up electric lighting in 1891 they would now have to raise over £200 of Corporation stock to pay for every £100 invested by private companies. At Leeds the Corporation had to pay £210 per cent., and at Sheffield £213 to buy out private companies. What, he asked, would the position of the Tramway Committee be if Cardiff had not taken up the provisional order? Surely, the Lighting Committee deserved some consideration for the work they had done.

Mr. Lewis Morgan seconded the motion.

Mr. Tom Andrews, chairman of the Tramway Committee, moved the following amendment:—"That a generating station for tramway traction be erected on its own site as a distinct undertaking from the lighting station." This, he said, was a fight between two committees. Alderman Carey had forgotten to tell the Corporation how much the Lighting Committee would charge the tramways if they supplied the energy.

After some further discussion, in which Mr. Beavan and others stated that they were not prepared to vote on the information before them, it was resolved, on the motion of Mr. Chappell, to adjourn the further consideration of the question until May 7th, the Tramway and Lighting Committees in the meantime to supply additional information to the members.

Alderman Carey stated incidentally that the Lighting Committee could supply energy for traction purposes at 95d. per unit.

Light Railways.—The Board of Trade has confirmed, after modification, the following orders made by the Light Railway Commissioners:—The Mid-Suffolk light railway order (Haughley to Halesworth, Debenham, and Westerfield); Rhyl to Prestatyn order; Dudley and District (Extensions) order.

Liverpool.—The Mersey Docks and Harbour Board have intimated that they will agree to the proposed application to Parliament by the Liverpool Overhead Railway Company for additional powers to enable the company to supply electricity for working traffic on the dock lines of railway. The Overhead Railway Company are applying to Parliament for powers to supply electricity to any buyer who chose to use it to work underneath the railway.

On Tuesday Mr. A. P. Trotter, electrical inspector to the Board of Trade, made an official inspection of the Prince's Road route electric tramway extension. He expressed himself highly satisfied with the whole of the electrical equipment.

Newcastle.—On 19th inst. the first rail was laid of the new system of electric tramways which is to be constructed by the Corporation at a cost of about half a million sterling. The ceremony was performed by Mrs. William Cail, wife of the chairman of the Tramways Committee. The total length of the new routes is 20 miles, and all the lines are double. The new tramways are to be worked on the overhead trolley principle, and are to be completed by April next.

TELEGRAPH AND TELEPHONE NOTES.

The American Pacific Cable.—A Reuter telegram from Washington says the Commerce Committee of the House of Representatives has substituted the Sherman Bill on the subject of the construction of the Pacific cable for the Bill which recently passed the Senate. The Sherman Bill differs from the message passed by the Senate in providing for the construction of the cable by private contract under Government supervision, while the Senate Bill provided for Government construction and working.

Anglo-German Telegraphs.—The *Financial News* correspondent at Frankfort says that the telegraphic service between London and Frankfort, especially so far as the Stock Exchanges are concerned, has recently become so inadequate and so liable to interruption that the Frankfort Chamber of Commerce has felt compelled to complain, on behalf of numerous merchants and others, to the postal authorities at Berlin. In reply, the latter, it is reported, have informed the interested parties that measures will be immediately adopted with a view to improving the situation, but that for the present no radical remedy for the existing state of affairs can be looked for until further direct communication between the two cities has been established. Negotiations, it may be said, have been pending for some time between the German postal authorities and the London General Post Office, having for their object the laying of a new Anglo-German cable.

Glasgow Telephones.—A Glasgow paper says that the outlook in connection with the Corporation Telephones is most promising. Up till the present time there has been a steady flow of applications for instruments. The majority of these have been

by means of reaction coils in the alternating side; it is

and resistance, and Thomson watt-hour meter. Each of the

received from business firms and private persons unconnected with the existing system in Glasgow, but there is also a fair proportion of the National Telephone Company's subscribers among the number.

The Pacific Cable.—A prolonged meeting of the Pacific Cable Committee was held at the Colonial Office last Friday afternoon. There were present Lord Selborne, Sir Francis Mowatt, Lord Aberdeen, Lord Strathcona, Sir Andrew Clarke, and Sir Julius Salomons, with Mr. Mercer (secretary). The proceedings were private.

Reuter's *Melbourne* agent says that the Australian Premiers will not discuss the cable question at the Conference which is being held in that city. The Postmasters of New South Wales and Victoria were probably to meet this week to decide the question.

The Pollak and Virág System.—It is reported that Messrs. Pollak and Virág, the inventors of the telegraph system which bears their name, and which was described in these pages during the course of last month, have, at the request of the Western Union Company, carried out a series of experiments on the wires of that company from Chicago to Milwaukee, and have succeeded in getting good results at the phenomenal speed of 155,000 words (?) per minute. This is the highest speed yet attained by the inventors, and the apparatus used seems to have differed in no essential manner from that described in the Electrical Review.

Rosario Telephones.—The *Review of the River Plate* says that the manager of the United River Plate Telephone Company in Rosario has applied to the Municipality for permission to place their mains underground. "This has evidently been done in view of the application of the representative of a syndicate for permission to establish another company in Rosario with underground mains. There is nothing like competition, and the inhabitants of Rosario now stand a chance of having a good service instead of the apology for a service they now have."

The Telephone in London.—With reference to the dispute between the National Telephone Company and the Bedford Estate authorities, which was mentioned in these columns last week, Messrs. Frederick Warne & Co., of Bedford Street, have written to the *Times* asking whether the Board of Trade could not intervene, and bring about at least a temporary understanding, so as to obviate the public inconvenience caused by the present *impasse*.

Wireless Telegraphy.—The *Bellerophon*, in reserve at Devonport, is to go to Falmouth for experiments in wireless telegraphy.

We read that the Japanese have repeated in a more energetic manner their request for the right to establish communication by wireless telegraphy on the Korean coasts and islands.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1891 duplicate)	Oct. 23, 1899 ...	...
Trinidad-Demerara (1871 original)	Apl. 14, 1900 ...	...
Mole St. Nicholas-Cape Haitien...	March 6, 1900 ...	...
Amazon Company's cable between Pará and Manaos...	Apl. 4, 1898 ...	Apl. 23, 1900
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Cayenne-Parsmaribo	Feb. 16, 1900 ...	...
Ceará Maranham	March 20, 1900...	...
Pará-Maranham	March 2, 1900 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Manila-Iloilo	Apl. 9, 1900 ...	...
Sitia-Rhodes...	Apl. 6, 1900 ...	...
Tarifa-Tangier	Jan. 2, 1900 ...	...
Zanzibar-Mombassa...	Apl. 10, 1900 ...	Apl. 19, 1900
Landlines.		
West Indies:—		
Haitien landlines	Apl. 21, 1900 ...	...
South African:—		
Communication with Mafeking and beyond	Oct. 13, 1899 ...	...
Communication beyond Aliwal North	Nov. 7, 1899 ...	...
Communication beyond Ladysmith (Natal)	Nov. 7, 1899 ...	...
Communication with offices beyond Kimberley and Bloemfontein	Oct. 18, 1899 ...	...
Communication with Rhodesia, &c., is at present by post. Lourenço Marques to Beira, and thence by wire.		
Communication with all offices of Colombia beyond Buenaventura...	Jan. 22, 1900 ...	...
Communication "*viâ* Hanekine" interrupted on Persian Territory	Feb. 24, 1900 ...	...
Ecuador landlines	Mch. 13, 1897 ...	...
Brazilian landlines, south of Macahe	Apl. 25, 1900 ...	...

CONTRACTS OPEN AND CLOSED.

OPEN.

Aarhus, Denmark.—April 30th. Tenders are invited for the delivery and laying down of the network for distribution of the current from the electric station in Aarhus. For particulars see "Official Notices" April 20th.

Birkenhead. — May 15th. The Corporation wants tenders for steam exhaust, feed water and drain pipework, &c., at the South End generating station. See "Official Notices" this week.

Burnley.—May 14th. The Corporation wants tenders for laying about 2,000 yards of cable on the solid or other approved system. See "Official Notices" this week.

Glasgow.—April 30th. The Corporation are prepared to receive tenders for the opening of trenches and the supplying and laying of underground conduits for telephone cables therein, &c. Specifications on application to Mr. A. R. Bennett, telephone engineer, City Chambers, Glasgow, upon payment of £2 2s. for each specification, which will be returned on receipt of a *bonâ fide* tender. See "Official Notices" April 20th.

Glasgow.—May 5th. Tenders for electricity meters are wanted by the Corporation. See "Official Notices" April 20th.

Heywood.—May 14th. The Corporation wants tenders for Lancashire boilers, economiser, pipe work, feed pumps, two steam dynamos, balancer, booster, travelling crane, batteries, switchboard connections, and station lighting mains, feeders and meters. See "Official Notices" to-day.

Keighley.—May 1st. The Corporation invite tenders for steel roofs and girders for electricity works.—Mr. J. M. Smyth, borough electrical engineer.

King's Lynn. — May 17th. The Corporation invite tenders for steam dynamos, Lancashire boiler, economiser, pipes, switchboard, and cables for electric lighting works. See "Official Notices" to-day.

London.—April 30th. The Great Eastern Railway wants tenders for stores and materials. See "Official Notices" April 20th.

London.—May 22nd. The Central Electric Supply Company, Limited, invites tenders for (1) two 1,200 I.H.P. Willans engines and three-phase H.T. generators (direct-coupled); (2) six three-phase H.T. motors direct-coupled to L.T. continuous current generator; (3) switchboards and connections. Specifications, &c., at the office of Prof. Kennedy. As to conditions and general particulars see our "Official Notices" April 20th.

London.—June 1st. The City Corporation Streets Committee invite proposals for the hire of an electrically-driven dust cart. See "Official Notices" April 20th.

Manchester. — May 7th. The Tramways Committee wants tenders for the supply of 150 car trucks, tramway bonds, and special track work, and points and crossings. See "Official Notices" to-day.

Mariupol.—May. The Secretary of State for Foreign Affairs has received a despatch from H.M. Consul at Taganrog, stating that tenders are invited by the municipality of Mariupol, not later than May 16th (29) next, for the construction and exploitation of an electric tramway and the installation of electric light in that town. Particulars may be examined on personal application at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Paddington.—May 14th.—The Vestry wants tenders for the execution of certain alterations to the existing electric lighting arrangements at the Baths. See "Official Notices" to-day.

Perth.—May 7th. The Burgh Commissioners want tenders for 45 enclosed arc lamps, and lamp pillars, with switch gear, &c. See "Official Notices" April 20th.

Rhyl.—May 14th. The Council wants tenders for water-tube boilers and other steam plant; steam dynamos, pumps, &c.; switchboard; mains, lamp-posts, &c.; battery; meters; crane, &c., for electricity works. See "Official Notices" April 20th.

Southampton.—May 1st. The Corporation wants tenders for a 300-kw. continuous current generator coupled direct to a medium speed vertical compound steam engine for the electricity works. See "Official Notices" April 13th.

Spain.—May 5th. The municipal authorities of Moguer (Province of Huelva) are inviting tenders until May 5th, for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Moguer, Huelva.

Sunderland. — April 27th. The Corporation wants tenders for the supply of two additional switchboard panels with instruments, &c., for the electric lighting station. See "Official Notices" April 6th.

CLOSED.

Bangor.—The City Council has accepted the tender of Messrs. Veritys for the switchboard at the electricity works.

France.—The French Post and Telegraph authorities in Paris have just placed contracts as follows: 40 tons of bronze wire 1⅛ mm. dia., Les Etablissments Monstez, Paris; 40 tons of copper wire 2½ mm. dia., La Compagnie Française des Metaux, Paris; 40 tons ditto., Messrs. Lazare, Weiler & Co., Paris; 80 tons ditto., Les Forges de Franche-Comté, Besançon, and 216 tons ditto., La Société Francaise d'Electro-Metallurgie, of Paris.

Glasgow.—The offer of Messrs. Walter Macfarlane and Co. has been accepted by the Corporation for cast-iron columns, bases, and brackets for electric arc lighting and tramway poles.

Maidstone.—The Urban District Council have provisionally accepted the tender of Messrs. Wallis & Sons, Maidstone, for the electric light station buildings, at £8,563, and of Messrs. Alton & Co., of London, for pipes, &c., at £1,432.

Stoke Newington.—The entire premises of the Stoke Newington Bon Marché are to be lighted electrically. The consulting engineers to the company are Messrs. Taylor & Field, and contracts have been let as under:—

Engines	.. .. ..	Messrs. Bilbie, Hobson & Co.
Dynamos	.. .. ..	,, McClure & Whitfield.
Arc lamps	.. .. ..	The Jandus Arc Lamp Co. (Enclosed). Crompton & Co., Limited (Open).
Wiring and switchboards	..	Messrs. Miskin & Rice.

FORTHCOMING EVENTS.

Friday, April 27th.—At 9 p.m. Royal Institution. Lecture by Lord Kelvin on "Nineteenth Century Clouds over the Dynamical Theory of Heat and Light."

At 8 p.m.—Physical Society.

Thursday, May 3rd.—At 8 p.m. Chemical Society. Meeting.

At 8 p.m.—The Röntgen Society. Meeting and Exhibition evening. Demonstrations:—Prof. F. R. Barrell: A new Method of Localisation, without plumb-lines or threads. Dr. Dellpratt Harris: On a Form of Focus-Tube designed to be Self-Heating. Mr. Chisholm Williams: A new X Ray Film—"Oristoid." Mr. Mackenzie Davidson will show, if possible, the Stereoscopic Fluoroscope. Exhibits by the President and others as follows: Mr. Bowron: (*a*) A portable 8-in. Spark Coil, with improved break; (*b*) a semi-portable 15-in. Spark Coil, with improved break; (*c*) a Milliamperemeter, for measuring the Secondary Discharge of Induction Coils. Mr. J. H. Gardiner: Skiagrams of British Reptiles, &c. Mr. Isenthal: Jet Mercury Break, &c. Dr. F. H. Low: A portable 10-in. Coil, &c. Messrs. Parsons and Eachus: A portable set, 8-in. Mr. E. H. W. Shenton: Skiagrams—Localiser Couch. Mr. Wimshurst: Influence Machine with Vulcanite Plates.

At 8 p.m.—The Civil and Mechanical Engineers' Society. Paper by Prof. R. H. Smith on "Valve Gears and Valve Diagrams.

At 3 p.m.—Royal Institution. Prof. Dewar on "A Century of Chemistry in the Royal Institution." Lecture II.

Friday, May 4th.—11.30 to 1 and 3.0 to 5.0. Cold Storage and Ice Association annual meetings, Examination Hall of the Royal Colleges of Physicians and Surgeons, Victoria Embankment, W.C. In the list of proceedings the following appear:—Morning session—Papers on "Recent Researches in Refrigeration" by Mr. G. Halliday; "Insulation and Insulators," by Mr. W. D. A. Bost. Afternoon session—"Electric Lighting of Cold Stores," by Mr. W. B. Esson; "The Design and Construction of Buildings for Ice Factories and Cold Storage," by Mr. P. Gaskell.

At 9 p.m.—Royal Institution. Lecture by Prof. T. E. Thorpe on "Pottery and Plumbism."

Monday, May 7th.—At 8 p.m. Society of Arts. First lecture on "The Control, Regulation, and Measurement of the Supply of Electrical Energy," by Major Philip Cardew, R.E.

At 8 p.m.—Society of Arts. Prof. Vivian B. Lewes on "The Incandescent Gas Mantle and its use." (Lecture I.)

Tuesday, May 8th.—At 8 p.m. Society of Arts. Nelson Dawson on "Art Metal Work."

Wednesday, May 9th.—At 8 p.m. Society of Arts. A. Moresby Whitelon "The Improvement of our Roads."

THE TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

The inaugural dinner of this Association was held at the Hotel Cecil on Wednesday evening, April 25th, a large attendance being secured. The chair was taken by the President, Sir Charles Rivers Wilson, G.C.M.G., C.B. The customary loyal and patriotic toasts were proposed by the President, and replied to heartily, Major-General Webber, C.B., R.E., responding for the "Imperial Forces," and paying a well-deserved tribute to their pluck and perseverance in facing difficulties of which we in peaceful occupations can have no real idea.

Mr. Balfour Browne, Q.C., proposed the "Houses of Parliament," and referred to private enterprise in tramways as having pulled the chestnuts out of the fire for the municipal authorities. He alluded to the well-known Clause 43 of the old Tramways Act as a silly clause, though we think he might rather have applied the word silly to the interpretations put on it by sundry arbitrators. Parliament had certainly choked off enterprise both by its tramway and electric light legislation. To this Mr. Atherley Jones replied. In proposing the toast of the evening, that of the "Tramway and Street Railway Industry," the President was singularly happy in his words. He gave a retrospect of the tramway industry in England from the first line, about 1860, in Birkenhead, followed by Liverpool in '61, and London in '63. We remember one in Darlington about the same year. From 1886 to 1894 there was stagnation, due to Clause 43 and its effects, but 1896 showed a forward step in the Light Railways Act. The President considered that there were many cases where it was right and proper for the local authorities to own the tramways in their respective areas, and insisted that the duty of the Association was to make for the friendly co-operation of municipal and private enterprise in tramway work. He referred at some length to the objects of the Association, its committees on legal, statistical, technical and general purposes, and called attention to the competition of the steam railways, and their opposition, notably in the case of the Coatbridge and Airdrie light railway, which had been quashed by the efforts of the railways—we need hardly add—greatly to the inconvenience of the public. The Association in its short life had already shown great vitality, but it had much to do. He touched further on the low limit of speed of 8 miles per hour—an altogether too low speed in country districts.

Prof. Thompson replied in a humorous speech, and we understood him to say that he did not himself object to a bit of stray current in his laboratory, and was often out of accord with brother professors in that he believed the public conveniences must not be sacrificed to the finesse of any laboratory or observatory which could not stand a bit of stray. This was not a horse age. It was an electrical age, and rules that had done for horse and mule work must give way to modern rules to meet the needs of to-day. He trusted Parliament would treat the electrical tramway question in an Imperial spirit, and not sacrifice the country to a too narrow spirit of municipal centralisation.

Mr. Young, of Glasgow, in responding to "The Guests," proposed by Mr. Geo. Richardson, of the North Metropolitan Tramways Company, stated that the tramways of Glasgow carry weekly three times the city's population, and that Glasgow cars carry more passengers than all the railways of Scotland and Ireland. The cars were the carriages of every section of the community.

Mr. McGraw, an American, also responded, and mentioned that New York had taken 15 years to obtain an underground railway, and he prophesied that in 15 years there would be no municipal tramway in Great Britain.

Mr. Alfred Smithson, of Leeds, proposed "The President," congratulated him on his being the head of the Association, and in his not hesitating to be so. He also, as a municipal man, thanked the President for the kind way he had referred to municipal enterprise, and trusted that the Association would assist to unite all tramway interests.

Mr. Garcke finally proposed a well deserved vote of thanks to the secretary, Mr. Wilcox, and in the course of his remarks he said, very happily, that if some of the municipal men would join the boards of private enterprises, and some of the private enterprise men would take positions in the municipalities, each side would learn to respect the other's difficulties. He could see both sides of the question, and it was the business of the Association to bring all parties to common agreement. The general feeling is, there is room for all, and Mr. Garcke well voiced this feeling, with which we fully agree, for there is an enormous field for tramways in this country. The fringe has not yet been touched. The Association has before it a great field for work, and we wish it and the tramways industry every success.

NOTES.

Obituary.—We regret to record the death of Colonel Sir Francis Arthur Marindin, K.C.M.G., R.E. (Retired) Senior Inspecting Officer of Railways, Board of Trade, who died on Saturday last in London. The *Times*, in the course of some notes on his career, says that as an inspecting officer of railways it fell to Sir Francis Marindin, in the earlier days of his connection with the Board of Trade, to examine the permanent way, bridges, stations, and signals of many new railways and branch lines, and subsequently to hold inquiries on a number of accidents. In 1891 one of these inquiries revealed an iniquitous system of over-working railway employés, a goods guard having been crushed to death between the buffers of two wagons while in a state of physical collapse after being on duty for over 22 hours at a stretch. Major Marindin's strongly-worded report on this incident led to the appointment of a Select Committee of the House of Commons, and to a notable improvement in the conditions under which railway servants were worked. Again, after the terrible Thirsk accident of November 2nd, 1892, Major Marindin declared most forcibly that it was the duty of all railway companies to adopt some combination of mechanical and electrical appliance which would make such an accident impossible unless the driver deliberately ran past fixed

signals. He also urged the engagement of relief signalmen, and the importance of housing the men near their work. By this repeated plain speaking, coupled with a complete mastery of his subject and great discriminating capacity, Major Marindin originated several most important railway reforms, besides keeping the lines throughout the country continually aware that the office at 8, Richmond Terrace, Whitehall, was not likely to allow irregularities to remain long unnoticed. In 1887 Major Marindin, having rendered important services in connection with the Egyptian State Railways, was made a C.M.B., and in 1897, on the occasion of the Diamond Jubilee, was promoted to the Knighthood of the Order. Sir Francis was 62 years of age.

We also regret to learn of the death on March 22nd, at Dunfermline, while travelling, after a short illness, of Edward J. Dale, of London, formerly of the firm of H. and E. J. Dale, opticians and electricians, London.

The Institution of Electrical Engineers (Irish Section).—At a meeting of this section held at the Royal Dublin Society on Thursday, April 26th, there was a discussion on "The Proposed Dublin Electric Light and Power Scheme."

Appointments Vacant.—The Shoreditch Vestry wants a chief clerk and book-keeper for the electric lighting department, at £200, rising to £250 per annum. See "Official Notices" to-day.

A chief assistant to the superintending engineer is required for the Bradford Electricity Works, at £150 per annum. See "Official Notices" to-day.

A local telephone manager is wanted for the Guernsey Exchange. See "Official Notices" to-day.

Lightning Conductors.—At a meeting of the Royal Institution of British Architects on Monday, Mr. Killingworth Hedges, M.I.C.E., who has re-arranged the system of lightning conductors at St. Paul's Cathedral, read a paper on this subject.

Lectures.—Prof. Carus-Wilson is to deliver a course of five lectures on "The Direct Current Motor, with Special Reference to Armature Reaction and Sparking" at the South-Western Polytechnic, commencing on Monday, May 7th. See our "Official Notices" this week for particulars.

On 17th inst., before the Aberdeen Mechanical Society, Mr. Robert Bissett read a paper on "Electric Traction," and Mr. N. J. B. Morrison one on "Accumulators."

Institution of Electrical Engineers' Conversazione.—The secretary of the Institution of Electrical Engineers informs us that the annual conversazione will this year be held on Tuesday, June 26th, in the Natural History Museum, South Kensington.

The Institution of Electrical Engineers.—The Institution will meet, by kind permission, at the Institution of Mechanical Engineers, Storey's Gate, S.W., on Thursday, May 3rd, 1900, at 8 p.m. If the discussion on Prof. Forbes' paper, read on April 26th, is concluded, the following paper will be read:—"The Calculations of Distributing Systems of Electric Traction under British Conditions," by H. M. Sayers, Assoc. Member.

The Institution of Civil Engineers.—The Council has made the following awards for papers read and discussed before the Institution during the past session:—A George Stephenson Medal and a Telford Premium to Sir Lowthian Bell, Bart., LL.D., F.R.S.; Telford Medals and Premiums to Messrs. H. H. Dalrymple-Hay, B. M. Jenkin, F. W. Bidder, and F. D. Fox; a Watt Medal and a Telford Premium to Mr. J. Dewrance; a Crampton Prize to Sir Charles Hartley, and Telford Premiums to Messrs. C. N. Russell and R. A. Tatton. The presentation of these awards, together with those for papers which have not been subject to discussion, and will be announced later, will take place at the inaugural meeting of next session. Mr. James Mansergh has been elected the new president.

CITY NOTES.

Eastern Extension, Australasia and China Telegraph Company, Limited.

The fifty-third half-yearly ordinary general meeting of the above company was held at Winchester House, Old Broad Street, E.C., on Wednesday afternoon, the Marquis of Tweeddale, chairman, presiding.

In moving the adoption of the report, the Chairman said he thought they would consider the report and accounts highly satisfactory. The gross revenue for the half-year was £339,450, showing an increase of £49,019 over the corresponding period of 1898. Half of that increase was derived from the Australasian traffic, and the remainder was spread over the rest of the system, more especially from China, Japan, and the Manila sections. The working and other expenses had amounted to £116,935, showing an increase of £16,850, which was almost entirely due to the expenses attending the maintenance of cables, which were considerably heavier than in the corresponding year. The balance of the increase was attributable to special payments made to the Philippine staff to recoup them for losses incurred during the insurrection and war, and to negotiation expenses. Comparing the figures for the whole year, the results were as follows:—Gross receipts, £663 811, compared with £567,713, an increase of £96,098; expenses, £224,201, against £202,958, an increase of £21,243. The usual dividend of 5 per cent. would be paid, which, with a bonus of 2 per cent., made 7 per cent. for the year. The revenue balance of £86 582 had been carried to general reserve fund, which now stood at £967,581, after having charged against the fund £68 901 for cable renewals carried out during the June half of 1899. It would also be observed that the subsidy of £32 400 per annum payable by certain of the Australasian Governments in respect of the duplicate cable between Penang and Australia ceased in October last. The original debenture debt amounted to £640,000, which would be entirely extinguished when the 330 debentures now outstanding were paid off on July 2nd next. The tariff guarantee agreements entered into several years ago with the Australasian Governments would also come to an end during the next few days, but a new agreement had recently been concluded with the Governments of South Australia, Western Australia, and Tasmania for immediately reducing the tariffs between the contracting Colonies and Europe, varying between 4s. 9d. and 5s. 1d. per word, to a uniform rate of 4s. per word, with proportionate reductions for Government and Press telegrams. Should the standard revenue fixed by the agreement be maintained, a further reduction to 3s. 6d. per word would take place on January 1st next, to 3s. per word on January 1st, 1902, and to 2s. 6d. on January 1st, 1903. The agreement, moreover, provided for the extension by the company, in conjunction with the Eastern Telegraph Company, of the third cable recently laid by the latter company to South Africa by laying a direct cable from Durban to Perth and Adelaide, *viâ* Mauritius, Rodrigues, and Cocos Island, and when the cable is opened for traffic the tariff between the contracting Colonies and South Africa will be reduced from 7s. 1d. per word to about 2s. 6d. The company had not asked for any subsidy or guarantee in return for the reduced rate and improved communication which the new cable would secure, but only for the right to have their own land wires and offices in the capitals of the contracting Colonies when the proposed Government Pacific or other competing cable was laid. At present the company's cable was 20,000 miles away from the principal capitals in Australia, and the traffic consequently was dependent on the good working of the long Government land lines across the Australian Continent, which land lines might not be so efficiently maintained as they were at present when the Governments owning them were federated, and in competition with the company for the international traffic. On the other hand, the new cable would terminate in the heart of Australia, and with the right to deal direct with the public and transmit their own traffic from end to end, the company would be placed on terms of equality with their opponents, and on that basis they did not fear the result should competition arise. Strange to say, grave concern had been evinced in Canada, New Zealand, Queensland, and elsewhere, at the prospect of the company enjoying in Australia the right so readily accorded in this country and in Canada itself, both to foreign and British cable companies, of direct dealing with the public; and not only had the company's motives and intentions been misinterpreted in these Colonies, but strong protests had been made by the Governments of Canada, New Zealand, and Queensland against the Australasian Governments granting any such privilege to the company. Nevertheless, three of the Australian Colonies had already agreed to grant the privilege, and the Governments of New South Wales and Victoria having accepted the agreement in principle, were expected to join in the arrangement very shortly. The protest to which he alluded was based on the ground that if the privilege were granted it would make the Government Pacific cable a financial failure, but the real objection appeared to be that the proposals of the company would in all probability, and at no very distant date, lead to a reduction of the tariff to 2s. 6d. per word, an objection which was scarcely consistent with the ostensible objects of the Pacific scheme—the breaking up of the so-called company's monopoly and the cheapening of the cable rates to Australia. It would almost seem that the promoters of the Pacific cable were not averse to creating a Government monopoly, and the consequent discouragement of all private enterprise, if by those means a tariff could be maintained sufficiently high to make the all-British cable a paying concern.

Mr. Bevan seconded the report which was carried.

Automatic Telephone Company, Limited.

The adjourned annual meeting of the above company was held at the Cannon Street Hotel on Thursday last week, Mr. B. Parker (the chairman elected at the last meeting) presiding.

The Chairman said that they would remember that the meeting held on January 25th was adjourned, and the new board then appointed was instructed to go into the affairs of the company and call a further meeting. Mr. Cooper was elected a director on that occasion, but had since retired, and would explain his reasons. Since that meeting he had received the unanimous support of his co-directors in all the steps he had taken to endeavour to place the affairs of the company into a satisfactory condition, and he saw no reason why that state of things should not continue in the future and so form a pleasant contrast to what had happened in the past. In order that the shareholders might understand what had been done it was necessary to refer to the past, and in doing so he had no wish to raise up old feuds, or to say anything which could be construed into a reflection on the doings of the old board or the managing director, Mr. Margowski. The company was established in July, 1897, to purchase the Apostoloff patents, then owned by the Apostoloff Automatic Syndicate, and the patents of Mr. Seligman Lui, who held a position under the French Government as Inspector of Telephones in Paris. The latter patents were said to be an improvement on or rather to supersede the Apostoloffs. The capital of the company was £100,000, divided into 400,000 shares of 5s. each. Of these shares, 40,000 were to be allotted fully paid to Seligman Lui, 40,000 set aside for providing £10,000 working capital, and 20,000 held in reserve for working capital. The balance, 300,000, were to be allotted fully paid to the Apostoloff Automatic Syndicate, and to be allotted *pro rata* among the shareholders of that company. Further, this company was to purchase the patents of Seligman Lui, and to allot 40,000 fully paid 5s. shares to Mr. Lui in payment, and appoint him consulting engineer at £1,000 a year, and £5,000 was to be deposited in joint names at the Bank of England to meet this salary. The inducement held out to the shareholders for entering into the agreement was that Seligman Lui was prepared to give up his position under the French Government and enter the service of the company. The company was formed, and at the first board meeting an agreement was sealed appointing Mr. Margowski managing director on exactly similar terms to those under which he held a similar position in the Apostoloff Automatic Syndicate. As the syndicate was constituted, that was, perhaps, not unreasonable, but as far as the company was concerned, he was of opinion that it was an agreement no board of directors should ever have entered into, it was one which, if ever Mr. Margowski chose to act upon it, absolutely abrogated all the functions of the board, and placed the entire control of the affairs of the company, including the disposal of the working capital, in the sole control of Mr. Margowski. His opinion was that the agreement was *ultra vires*, and not binding on the company, but Mr. Margowski contended otherwise, and refused to agree to cancel it, although he stated that he had no intention of acting upon it, either now or in the future. With regard to Mr. Seligman Lui, an agreement was entered into between him and Mr. Margowski, afterwards adopted by the company, providing for the allotment of 40,000 shares to Mr. Lui, and the deposit of £5,000 at the Bank of England for his five years' salary. It also contained a clause reserving to Mr. Lui the right to choose the date at which he should leave his present official position. Mr. Margowski then with great energy, proceeded to get the patents transferred to the company, and Mr. Seligman Lui was instructed to make a model of his invention, and £200 was placed at his disposal to pay the costs. No deposit was made at the Bank of England. One year having elapsed, and no model being forthcoming, the salary to Mr. Seligman Lui was stopped. Law proceedings were taken, and the company had to pay the salary and the costs. In consequence, the position between Mr. Seligman Lui and the company became strained, and Mr. Lui refused to have anything further to do with the company, and that condition of things existed at the time he (Mr. Parker) was appointed chairman. Immediately after his appointment he set to work to arrange matters with Mr. Lui, and after great negotiation they had come to terms. The agreement provided that Mr. Seligman Lui was to receive £575 on account of arrears of salary, and that had been paid. He was, farther, to proceed with all despatch to complete a working model of his invention, and no further salary was to be paid him until it was delivered in London in working order, when the salary would be paid up, as provided in the first agreement. The agreement further provided—and Mr. Margowski was a party to this—that so long as the present directors had the confidence of the shareholders, as expressed by a show of hands at any meeting, Mr. Margowski would not use his voting power on a poll for removing or preventing the re-election of any such directors. With regard to the financial position of the company, there was about £2,500 working capital left, and a reserve of 20,000 unissued shares. The liabilities for rent was about £350 a year, and that would be reduced to one-half. There was likely to be a claim for £150 by the liquidator of the Apostoloff Syndicate, and a claim for costs and debts of the liquidation of about £850 by Mr. Cooper. All they could do now was to wait for the model, when they could judge of its value, and if he was to put faith in the representations of Mr. Seligman Lui, they would not be disappointed.

Replying to a request, the Chairman read the agreement between the company and Mr. Margowski, which provided that Mr. Margowski was to be the first managing director, "with power to sign cheques, bills, contract deeds and other documents for and on behalf of the company without the necessity of the same having been countersigned by any other director or the secretary," and he had also full power to deal with the assets of the company as he thought best in the interests of the shareholders.

Mr. Cooper said he came on the board with an unbiassed mind, but in the face of such an agreement as that he was bound to retire. Another reason was that he did not consider the books were well kept; and there were two sets of books, a clean set and a dirty set. While the managing director absolutely controlled the company he could not sit on the board.

Mr. Margowski said the books were always in Court, so that the secretary had been unable to keep them posted to date. Every solicitor wrote notes on the books and they got into bad condition, and therefore he ordered them to be copied, and the new books were submitted to the board so that it could be seen that they were accurate copies. With regard to his agreement, he had never abused his power, but, as he was the largest shareholder, he was bound to stick to that agreement to protect himself.

Mr. Gibbs (a director) also expressed the opinion that the agreement with Mr. Margowski ought not to exist. With regard to Mr. Seligman Lui's apparatus, he considered it very valuable. He believed its completion was not far off. There was only one thing in existence which could in any way come into competition with it, and that would not embrace the wide areas that Mr. Lui's apparatus would.

A lengthy discussion, or rather conversation, took place between a number of shareholders and Mr. Margowski as to his relinquishing his agreement, but this Mr. Margowski would not consent to do.

The Chairman said that with regard to the accounts presented at the last meeting, he believed they were substantially correct, but there were one or two items he would like to inquire further into, and there was no necessity to adopt them at that meeting.

The proceedings then terminated.

The Buenos Ayres and Belgrano Electric Tramways Company, Limited.

The second annual general meeting of the shareholders of this company was held on Thursday of last week at Winchester House, Old Broad Street, under the presidency of Mr. J. B. Concanon.

The Chairman, in moving the adoption of the report, after apologising for the absence of Mr. John Morris, the chairman of the company, through indisposition, said the shareholders would remember that at an extraordinary meeting sanction was obtained to create £200,000 second debentures. £120,000 of that amount had been raised on satisfactory terms, and the board hoped and believed that that would be sufficient for their requirements. As to the accounts, he said it was very difficult to enter into the details with any advantage to the shareholders, for they represented a mixture of both horse and electric traction. The broad facts were that up to February 16th last year one section only of the new line, and that quite an isolated section, was working electrically. Upon that date the line was continued from Retiro to Plaza, and later on it was continued in the other direction to Belgrano. By that route an entirely new electric tramway line was opened from Buenos Ayres to Belgrano. Although there was very little intermediate traffic between the various points, the receipts per mile were 9¼d., which they considered, on the whole, satisfactory; but, on the other hand, the expenses were abnormally high for an electric line. They made the initial mistake of running far too generous a service on some of the sections, more particularly on that from Plaza to Retiro. They started with about 1½-minute service, but they found that the number of people using the cars did not justify that, and therefore, at the commencement of this year they had reduced the service. That had resulted in a considerable saving of expense, and at the same time their receipts were practically the same. They took their current from a local lighting company, and owing to disadvantageous circumstances their average consumption of current per mile had amounted to 1·3 Board of Trade units. They had already got that down to 1·2, and when the feeder system for the cables was in full operation, they hoped to get the consumption down to 1 unit per mile run, and having regard to the high rate of speed at which their cars ran, that would be satisfactory. The work of electrically equipping the whole of the old line was being pushed on with all speed, with a view of bringing the remaining and most profitable lines into work. The company had already derived considerable advantage from the presence of Mr. Brown, the new director, at Buenos Ayres. Important all round economies had been made and others were in prospect. The only difficulty they now had to encounter was a disinclination that existed on the part of the authorities in the Le Plaza to allow them to use overhead wires. He hoped, however, that they would see their way to give their consent, but if not they would have to adopt for that part of their system the conduit or underground system. That would entail a somewhat larger expense and some inconvenience, but it was not impossible to work the combined systems. As to their future prospects, he had received a letter from Mr. Brown, in which he gave the opinion—to which, however, they must not bind him, seeing that he had only been in Buenos Ayres about two months—that their expenses would drop to 60 per cent., and that their profit might easily reach £65,000, in which case they would not be so badly off for next year, and unless something unforeseen should occur there ought to be a steady increase in their profits for some years to come. After paying their first and second debentures and their first and second preference shares, that amount of £65,000 would leave a satisfactory sum over for the ordinary shareholders; but it was right that he should remind them that before the ordinary shareholders got a dividend they had to wipe out the arrears on the second preference shares accrued and due up to December 31st last of 11s. per share, or a total of £15,125, and of course the dividends would also accrue

on this current year for the second preference before the ordinary shareholders could get anything. According to Mr. Brown's idea, he saw no reason why the line should not be opened throughout in July next.

Mr. W. Wilson seconded the motion, and the report was adopted.

Oriental Telephone and Electric Company, Limited.

Sir Auckland Colville presided at the annual meeting of this company on Wednesday at Cannon Street Hotel. In moving the adoption of the report, he said the directors were pleased that the report was so satisfactory. Increases all round had been attained, both in the numbers of subscribers at the different centres and in receipts, whilst the expenses were but in proportion to the heavier work entailed. After providing for the usual dividend of 5 per cent. there was, therefore, a balance to be dealt with of £4,507 as compared with £3,348 the year before. The board hoped that the proposal to add a larger amount to reserve fund than on previous occasions would commend itself to the shareholders. Much reconstruction of an expensive nature, necessitated by the increase of business, is now taking place in the localities where the company's operations are carried on. During the present year the old reserve fund, which was now available only for capital expenditure, would have been drawn upon to a considerable extent, and it was therefore desirable that the new reserve fund should be brought up to a fair strength so as to become available again for all and any purposes whenever necessary, such as was the case in former years. Whilst the directors believed that the best interests of the company were served by that policy, they were pleased to add that should the steady development of the company's business render desirable, an increased dividend might possibly be recommended at a later date when that question again came up for consideration. The closing of the Shanghai Exchange was a matter of regret. The Council imposed on the China Company conditions which would have involved an expenditure of fresh capital to the extent of from £15,000 to £20,000. That sum would have had to be provided by this company, but the directors came to the conclusion that better and safer employment could be found for so large an amount in their exchanges nearer home, especially in Egypt. The Hong Kong branch, on the other hand, was prospering, and was sufficiently provided with funds for a considerable time to come. Indeed, they hoped that that branch would be in a position next year to contribute to their annual dividends.

The motion was seconded by Mr. Lloyd, and carried.

The retiring directors and auditors were re-elected.

The Kidderminster and District Electric Lighting and Traction Company, Limited.

The report of the directors for the period from July 27th, 1899, to December 31st, 1899, which was presented at the second ordinary general meeting of the company at the registered offices, Donington House, Norfolk Street, Strand, W.C., on Wednesday, April 25th, 1900, reads as follows:—

"*Capital Account.*—The prospectus of the company was issued in July, 1899, and 3,000 ordinary shares and 3,000 5 per cent. cumulative preference shares of £10 each were allotted. The total capital expenditure to December 31st, 1899, on account of buildings and plant for electric lighting amounted to £6,676 15s. 1d. The company hold 5,600 shares of £10 each of the Kidderminster and Stourport Electric Tramway Company out of 5,720 shares issued, and had paid £22,400 on account of calls to December 31st, 1899.

"*Profit and Loss Account.*—The gross profits, including the amount receivable from the Kidderminster and Stourport Electric Tramway Company for dividend on the shares held by this company, amount to £1,558 14s. 11d., and after deducting the expenses there remains a net profit of £1,458 9s. 4d. The directors propose that this amount should be applied as follows, viz.:—

To dividend on cumulative preference shares from July 31st to December 31st, 1899 ...	£312	10 0
To be carried forward to next account ...	1,145	19 4
	£1,458	9 4

"*Tramways.*—The directors attach to this report a copy of the balance-sheet and profit and loss account of the Kidderminster and Stourport Electric Tramway Company. The net profits for the year in respect of the tramways amounted to £2,165 14s. 11d., and this amount has been applied as follows, viz.:—

To dividend of 5s. 6d. per share on 5,720 shares	£1,573	0 0
To depreciation fund	500	0 0
To be carried forward to next account ...	92	14 11
	£2,165	14 11

"*Electric Lighting.*—The work of installing the plant is well in hand, and the directors hope to be able to commence a supply of current during the summer.

"*Directors.*—Mr. J. S. Raworth has been elected chairman of the company in the place of Mr. Emile Garcke. Mr. W. L. Madgen has been appointed a director of the company. Mr. C. S. Drummond has resigned his seat on the board and the vacancy thereby created has been filled by the appointment of Mr. C. Shirreff B. Hilton. Messrs. Emile Garcke and C. Shirreff B. Hilton are the directors who retire by rotation, and they are eligible for re-election.

"*Auditors.*—Messrs. Walter J. Kershaw & Co., the auditors, retire, and they offer themselves for re-election.

Tramways.

	M.	F.	Ch.
Miles open—			
Route miles	4	4	7
Single lines	4	2	4
Double line		2	3
Number of passengers	758,500		
Average receipts per passenger	1·69		
Average expenditure per passenger	1·07		
Proportion of expenses to receipts	63·19		
Number of cars in stock	13		

The second ordinary general meeting of the shareholders of this company was held on Wednesday at the offices, Donington House, Norfolk Street, Strand, Mr. J. S. Raworth, M I C.E., presiding.

The Chairman, in proposing the adoption of the report, reminded the shareholders that the company was formed for the purpose of combining, as far as it was possible to combine them, the tramway service and the lighting by electricity of Kidderminster and district. There was a company called the Kidderminster and Stourport Electric Tramway Company. That company possessed a line of tramways between Stourport and Kidderminster, and it was also contemplated to make an extension of the tramway to Bewdley. That undertaking was viewed with very great pleasure by the inhabitants of Bewdley, and the authorities there had asked them to undertake the work. They were on extremely friendly terms with the Corporation of Kidderminster, and though they had not seen their way to support their proposition exactly in the form in which they put it before them, they had come to an agreement with them whereby they would take away all opposition on their part to the granting of the order. The only point of difference between them and the Corporation was as to the practicability of carrying on a tramway service through what was called the "bull ring," which was a very narrow street in the town. They had therefore agreed with the Corporation that they would only use the connection through the "bull ring" for the purpose of transferring current from their power house on to the Bewdley line, and *vice versâ*. They had made an arrangement whereby they took over the electric lighting order which was granted to the Corporation of Kidderminster, and in order to make the whole undertaking more economical, the two undertakings would be combined, as far as possible, together. They held 5,600 shares of £10 each in the Kidderminster and Stourport Electric Tramway Company out of the 5,720 shares issued, and up to December 31st they had paid £22,400 on account of calls due. Other amounts had been spent on capital to the extent of £6,676 on buildings and plant for electric lighting, and there was every prospect that the supply of current for the purposes of electric lighting would be undertaken in the course of this summer. The gross profits, including the amount receivable from the Kidderminster and Stourport Electric Tramway Company for dividend on the shares held by them in that company, amounted to £1,558 14s. 11d., and after deducting the expenses there remained a net profit of £1,458 9s. 4d. They proposed to apply that amount as follows:—To dividend on the cumulative preference shares £312 10s., and carry forward to next account £1,145 19s. 4d. Turning to the balance-sheet, they would find that the accounts were prepared in a form which was not quite usual in tramway undertakings, but which was well understood in electric light undertakings. They had to prepare the accounts in a certain manner for the Board of Trade, and they had thought it better to adopt the same form for the shareholders as being more convenient. The revenue was almost entirely derived from their dividends in the Stourport Electric Tramway Company, and on the other side they would notice that they were carrying forward to net revenue a balance of £1,448, and the only items which had been spent in management, general printing, &c., were £52 4s. and £32 2s. 11d. respectively, so that the total expenses of managing the business during the past eight months had only amounted to £84 6s. 11d. In addition, there was a special charge of £15 8s. 8d., the cost of obtaining a Stock Exchange quotation. In conclusion, the chairman said that, for the information of the shareholders, the directors had included in the report the accounts of the Stourport Electric Tramway Company, in which they were so largely interested, and he considered that so far they were exceedingly satisfactory.

Mr. C. S. B. Hilton seconded the motion and the report was adopted.

Winchester Electric Light and Power Company, Limited.

The directors' report of this company, which was adopted at the meeting held at Winchester some days ago, as already reported in the Electrical Review, reads as follows:—

"The directors have the honour to lay before the shareholders the second annual statement of accounts for the year ending December 31st, 1899, duly audited by the official auditor. The contract with Messrs. Edmundsons for the running of the works terminated on July 1st last, so that these accounts do not represent exactly the working of the undertaking for the past year. The directors are satisfied with the reception the electric light has obtained at Winchester. Ten thousand 8-c.p. lamps were connected by the end of last year. Further applications continue to be received. The accounts show a balance to net revenue account, after paying all expenses (including interest on debentures), amounting to £323 12s 2d., of which it is proposed to apply £202 6s. 6d. in payment of a dividend at the rate of 2½ per cent. per annum for the year; and to write off £121 [illegible], the balance, in reduction of £197 17s. 4d., the preliminary expenses. During the year another large engine and dynamo set and a third boiler have been added at the works, and

large extensions of the mains have been laid, to meet the public demand. The company continue to do a fair share of the wiring work in the city, and introduced last autumn a system of free wiring, ½d. per unit used being charged as rental. Of the directors, Mr. F. E. Gripper retires by rotation, and being eligible, offers himself for re-election."

The Dudley, Stourbridge and District Electric Traction Company, Limited.

The directors' report, presented at the eighteenth ordinary general meeting of shareholders held at Donington House, W.C., on Tuesday, 24th inst., reads as follows:—

"The directors beg to submit their report and the statement of accounts for the year ended December 31st, 1899. The electrical equipment of the lines was inspected by the Board of Trade on July 25th, 1899, and the lines have been worked electrically since July 26th last. The Board of Trade have granted the usual certificate for seven years from February 2nd, 1900.

"*Capital Account.*—During the year £53,968 8s. 11d. has been expended in respect of the electrical equipment, and this account now amounts to £83,308 8s. 11d., of which £71,173 0s. 4d. is owing to the British Electric Traction Company. The directors propose to issue the balance of the unissued 8,211 ordinary and 19,375 preference shares of £5 each in order to discharge this amount, and to provide capital for the completion of the Dudley light railways which are now in course of construction and will, it is hoped, be opened for traffic during the summer.

"*Profit and Loss Account.*—The total revenue for the year amounted to £11,504 16s. 2d., and the total expenditure to £7,195 15s. 3d., leaving a net profit of £4,309 0s. 11d., which, added to the amount of £919 8s. 8d. brought forward from last account, makes a total sum of £5,228 9s. 7d. available for distribution. The directors propose that this amount should be applied as follows:—

	£	s.	d.
Dividend at the rate of 5 per cent. on the cumulative preference shares to December 31st, 1899	146	5	0
Dividend at the rate of 3 per cent. per annum on the ordinary shares for the past year	1,768	7	0
Amount to be placed to depreciation fund ...	1,000	0	0
Balance to be carried forward to next account ...	2,313	17	7
	£5,228	9	7

The depreciation fund will then amount to £6,079 0s. 8d.

"*General.*—An agreement has been entered into with the British Electric Traction Company whereby that company agrees to transfer to this company the whole of the lines to be authorised by the Dudley Light Railways (Extension) Order, 1899, when constructed, for the sum of £28,500. The map shows these lines and also the lines already owned by this company, and the state of progress of the light railways under construction as at January 31st last. The above agreement also secures to this company the right to work the Kinver light railways for a period of two years on the basis of actual cost, plus a clear profit of 10 per cent.

"*Directors.*—Mr. H. F. Woodward, late secretary of the company, has been appointed a director of the company. Mr. C. S. Drummond has resigned his seat at the board, and the directors have appointed Mr. C. Shirreff B. Hilton to fill the vacancy thereby created. Messrs. C. A. Edge and C. Shirreff B. Hilton are the directors who retire by rotation, and they are eligible for re-election.

"Messrs. W. J. Kershaw & Co., the auditors, retire, and they offer themselves for re-election"

Mr. Emile Garcke presided at the annual meeting of this company, held at Donington House, Norfolk Street, W.C., on Tuesday.

In moving the adoption of the above report, the Chairman said that as this was practically the first meeting of the company held since the conversion of the line from steam working to electric traction, he would make a few remarks on the past and present positions of the company. Some years back the British Electric Traction Company acquired the majority of the shares in the old company with a view to introducing electric traction, and after arranging with local authorities for an extension of tenure, capital was expended upon the reconstruction of permanent way, &c., necessary for the conversion. The agreements with all the local authorities were not the same, they varied according to the circumstances, but speaking generally, they had an extension of life of between 21 and 35 years, according to the various sections. Powers had also been obtained for extensions in the district, which they believed would very materially improve the results of working upon the main line from Dudley to Stourbridge. Those extensions had been promoted under the Light Railways Act, and had been made under two separate orders. The first order was confirmed by the Board of Trade in 1898, and the lines then authorised are now nearing completion. The second light railways order was confirmed only this month, but no time would be lost in proceeding with the construction of the lines, and when they were completed the company would have a total system of over 16¾ miles, as compared with the original 5½ miles which the company worked before the British Electric Traction Company obtained control of the undertaking. As to the constitution of the company, the name of the company had been altered, the capital largely increased, changes had taken place in the directorate and officials, and the offices had been removed to Donington House, which would enable the undertaking to be carried on in accordance with the general principles of administration of the British Electric Traction Company, by which means they hoped to effect some economies and increase the efficiency of working. The capital necessary for the electrical conversion of the line had so far been provided by the British Electric Traction Company under various agreements. The increase which had already been made in the issued capital was not very large, although they had taken powers to very largely increase the authorised capital, with a view later on of making an issue so as to provide for the repayment of the moneys of the British Electric Traction Company in payment for the new works executed by them. The chairman proceeded to refer to the agreements which had been made for completing the various authorised lines and for the working of several adjoining lines which were more or less under the control of the British Electric Traction Company. With their new lines, and by virtue of agreements with the B.E.T. Company for mutual running powers, passengers would be able to reach any other tramways in the very large and important district of South Staffordshire. Instead of their being a 5½ mile line, their system would form in a measure the centre of a very much larger system, and the traffic was almost certain to be very much greater per mile than it had been in the past. The existing lines were opened by electric traction in July last year, and since then a very satisfactory service had been provided, but the character of the cars, the power house, car depôts, &c., had been arranged with a view to providing for a much larger service of cars than was run on the 5½ miles. In view of those circumstances it was difficult, if not impossible, to accurately gauge the results of the past few months' working as affording any indication of what will be the conditions of working in the future, when the other lines are in operation. Nevertheless, it would be of interest to state that not only the number of passengers carried, but also the receipts had increased by more than 50 per cent. over what they were when the lines were worked by steam. The provisional arrangement they had made to work the Kinver light railways on behalf of the B.E.T. Company, as soon as completed, would produce a clear net profit to this company whatever the results of working the line might be. The Kinver lines were opening up entirely new ground, and it was difficult to make any agreement of a permanent character until some experience had been gained as to what would be the amount of traffic. A very large traffic was anticipated. The provisional agreement might be made permanent, or modified as circumstances showed to be necessary after the results in the working of the line had been obtained. They proposed to pay 3 per cent. on the ordinary shares, but it would be seen that it would have been possible to pay a very much larger dividend, but in view of the large amount owing to the British Electric Traction Company for construction works, which at present did not figure in the capital account, the directors felt it more prudent to pay the dividend proposed and carry forward a sum until the capital account had been adjusted in a way providing for the liabilities of the company. It should be a consolation to them that they were able even during the period of reconstruction to maintain the full rate of dividend which had been earned during the previous period of steam working. They all knew that considerable interruption was caused by converting from one to another system.

Mr. Woodward seconded the adoption of the report and declaration of dividend which was carried.

The retiring directors and auditors were re-elected.

Prospectuses.

A Prospectus is in circulation, inviting applications for 10,000 5 per cent. cumulative preference shares of £5 each in W. F. Stanley and Co., Limited. This company has been formed to acquire the well-known business of Mr. W. F. Stanley as carried on at Great Turnstile Street, W.C., and other places in London, since 1854, in the manufacture of high-class optical, geodetic, mathematical, surveying, drawing, and philosophical instruments. The total capital is £120,000, divided into £50,000 preference, and £70,000 ordinary capital, all in £5 shares; 10,000 of the ordinary are taken by the vendor in part payment of the purchase price (£100,000). He also takes £50,000 in cash or partly in preference shares. The remaining 4,000 ordinary shares are reserved for future issue. The list of applications opened on 24th inst., and closes to-morrow 28th inst.

The Park Foundry Company, Limited,

Which is to acquire and extend the well-known business of the Park Foundry Company, situated at Belper, Derbyshire, has issued in the Nottingham district, a prospectus of £50,000 5 per cent. debenture stock. The capital is £50,000 in 50,000 ordinary shares of £1 each, and 50,000 debentures. The vendor takes the whole of the ordinary shares, now issued, viz., 40,000, the remaining 10,000 to be held in reserve for further working capital if necessary. The business was established in 1873 by Mr. Ebenezer Smedley at Queen Street for the manufacture of ordinary castings, and has been of a progressive character, new works being erected in 1877 at New Road, and again in 1884. The firm have now found further extension necessary, and have built and equipped additional new and up-to-date premises on their own freehold land in Derby Road. In order to further develop the works and enable the company to entirely finish their own productions without any outside assistance, they have agreed to acquire the engineering plant of the Midland Electrical and General Engineering Company, Limited, Nottingham, and new workshops are about to be erected on the company's land at Derby Road, Belper, for the erection and working of this plant. The purchase price has been fixed by the vendor, who is the promoter, at £85,000.

Isle of Man Tramways Company.

We read in a financial paper that the directors of the Isle of Man Tramways and Electric Power Company, Limited, have issued a circular letter to the shareholders stating that the directors regret that

the delay in the arrival of the balance-sheet relative to the suspension of Dumbell's Bank has placed the company in an extremely difficult position, rendering it necessary to call in Messrs. Turquand & Youngs to prepare a statement of the affairs of the company. The investigation has taken longer than anticipated, but the directors hope to receive the report in a few days, after which the shareholders will be called together at the earliest date.

The Charing Cross and Strand Electricity Supply Corporation, Limited.

At an extraordinary general meeting that was held on 24th inst. it was decided to increase the capital of the company to £800 000 by the creation of 30,000 new ordinary shares of £5 each and 60,000 new preference shares of £5 each. It was pointed out that owing to the demand it became absolutely necessary for the company to build one new station, and possibly two. In the course of his remarks dealing with the scheme of the company, the chairman said he had no doubt that when they got into the City they would reap a very rich harvest.

St. James's and Pall Mall Electric Light Company.—The amount of electricity sold for the quarter ended 25th ult. is returned at 1,599,768 units, estimated to produce £28,529, as against 1,161,987 units, which produced £20,964, for the corresponding period of last year.

Statutory Meeting.—The first statutory general meeting of the Manchester and Liverpool Electric Railway Syndicate, Limited, was held on 19th inst. at the offices of the Exploration Company, Cornhill, London. The meeting was purely formal, and was held in compliance with the requirements of the company's Act.

Cuba Submarine Telegraph Company.—The directors propose a dividend on the ordinary shares of 6 per cent. per annum for the half-year ended December 31st last.

New General Traction Company.—The transfer books will be closed from 28th inst. to 12th prox, inclusive.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending April 21st, 1900, were £757 14s. 11d.; receipts for corresponding period, 1899, £301 4s. 11d.; aggregate for half-year to date, £3,525 1s. 2d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending April 20th, 1900, were £3,899 14s. 4d.; corresponding period, 1899, £2,618 14s. 10d.; increase, £1,280 19s. 6d.

The City and South London Railway Company.—The receipts for the week ending April 22nd, 1900, were £1,211; ditto April 23rd, 1899, £1,025; increase, £186. Total receipts for half-year, 1900, to date, £19,688; corresponding period, 1899, £17,290; increase £2,398. Miles open April 22nd, 1900, 3⅞; April 23rd, 1899, 3⅛

The Dover Corporation Tramways.—The receipts for the week ending April 21st, 1900, were £247 7s. 11½d.; April 22nd, 1899, £160 0s. 6d.; increase, £87 7s. 5½d. Total receipts to date, 1900, £2,497 0s. 11½d.; corresponding period, 1899, £2,421 6s. 9d.; increase, £65 14s. 2½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,955; 1899, 4,245. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, April 20th, 1900, were as follows:—D. U. T. Co., horse cars £72 10s. 5d.; ditto, electric cars, £4,239 9s. 10d.; D. S. D. Co., electric cars, £1,505 12s. 11d.; total, £5,917 18s. 2d.; corresponding week last year—D. U. T. Co., horse cars, £1,800 0s. 1d.; ditto, electric cars, £1,064 18s. 6d.; D. S. D. Co., electric cars, £868 17s. 0d.; total, £3,733 15s. 7d.; increase, £2,183 17s. 7d. Aggregate to date, £62,290 12s. 2d.; aggregate to date last year, £52,540 6s. 8d.; increase to date, £9,750 5s. 11d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 16 miles electrically, 26 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending April 22nd, 1900, amounted to £1,665; corresponding week last year, £1 352: increase, £313. Total increase in traffics for half-year to date, £702. 1900 includes Bank Holiday.

The South Staffordshire Tramways Company.—The receipts for the week ending April 20th, 1900, were £1,066 19s. 7d.; April 21st, 1899, £606 16s. 2d. Aggregate receipts for 16 weeks, £10,248 0s. 6d.; last year, £9,816 0s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

Markets in the Stock Exchange have moved downwards as a whole during the past week. Hardly one has escaped from the semi-slump that was heralded by the severe fall in American Rails, and accompanied by a sharp drop in Government securities. What with the National War Loan standing below par, and the money market giving no symptoms of loosening, there are, indeed, no particular allurements at present for the investor or speculator who is thinking of entering the markets when the way looks clear. The long-protracted wait of Lord Roberts at Bloemfontein is having a paralysing effect upon business all round the Stock Exchange, and the fears that a new National War Loan will have to be made shortly are naturally increasing with every day's delay on the part of the Commander-in-Chief.

Under these circumstances, it is not surprising that our price lists fail to exhibit a gain in a single security. But it is little less astonishing that the falls which have taken place are so few and far between and so small. Take the case of the electrical railway market. Waterloo and City Ordinary has shed a point, but that is the only recordable change, and one that is of very little moment, it having been caused by the general weakening in the investment departments, more particularly amongst those of the Home Railway division. Central London shares and City and South London stock, and Great Northern and City "A" are all unchanged, despite the fact that stocks in the "heavier" companies have fallen smartly. City and South Londons are a shade more difficult to deal in, perhaps, but Centrals maintain their quotations with great firmness, sellers holding off for a month or two longer, when the new line will be declared open to the public. Metropolitan District stock has experienced a fall of 3⅜ to 30, but Metropolitan Consolidated keeps steady at 106.

Westminsters are the weak spot in the electric supply market, and Charing Cross have been freely offered during the week. The meeting of the Westminster Company, when the price of the new issue will be fixed, takes place on May 11th. We may observe, in passing, that the jobbers in the Stock Exchange who deal in electric shares addressed a letter to the directors of the Westminster Company, pointing out strong reasons why the new issue should be made at par, and not at £10, as one party proposes. This letter cannot fail to exercise some influence in the considerations of the directors. The position of the Charing Cross and Strand Company is giving rise to some anxiety amongst shareholders, who do not see how the City business is going to be made a payable proposition. Surely it is a little bit late in the day to think about such a thing now?

The London Electric Supply Corporation has not suffered to any great extent through its appearance in the police courts this week for failing to supply a proper amount of current to some of its customers, and the shares are unaltered in price. Edmundsons have declined 5s., and City of London Ordinary are out of favour, it being cheaper to buy the new shares than the old.

It is interesting to note that while Electric Supply shares lose ¼ or ½ occasionally, the market for gas stocks is decidedly flat. The present price of coal has given rise to a general desire amongst proprietors of gas securities to realise their holdings, and the consequence is a general fall all round. Several of the companies will undoubtedly be obliged to raise their prices to consumers, although we do not suppose they will do this while the Commission is sitting; and it must be remembered that with an advanced rate for gas, a diminished dividend will fall to stockholders. The Gas Light and Coke Company, for one, is pretty sure to have to raise its price for gas after the Commission's labours are completed.

It is pleasant to be able to welcome the Johnson-Lundell Electric Traction Company, Limited, and we only wish that all new comers could present so fair a front. The capital is not too large; ample allowance is made for working capital, the directors and their friends have subscribed for more than a third of the public issue, the prospectus is reasonable and sober, and above all, there has been no attempt to create a spurious pre-allotment market in the Stock Exchange. Possessed of such credentials, it would indeed be a wonder if the company should not "go," but on that point we have no doubts. In Newcastle alone the capital, we hear, was subscribed twice over.

The telegraph market continues the even tenour of its way with only a single alteration in its quotations. Anglo-American Deferred lost ¼ early in the week, consequent upon the stoppage of the boom in American rails. The old bogey about the new German cable has also been revived, and is again doing duty for the bears. The stocks of the Eastern lines have undergone no alteration, but the additional press censorship is understood to have a bad effect upon the Eastern Telegraph Company's receipts. That undertaking has also, it is said, lost its case against the Cape Electric Tramways Company in the Law Courts of Cape Colony. The Eastern Company maintained that its lines were damaged by the tramways, but the judges before whom the case was brought decided unanimously against the telegraph company. An appeal followed, and the news now comes that the Cape Electric Tramways has again triumphed. In the Stock Exchange, however, the report was treated with some reserve, and the price of the Tramways Company's shares advanced only 1s. 3d. to 1½ If the Court of Appeal has really decided against the Eastern Telegraph, Cape Electric Tramways shares ought to be worth buying.

The new Marylebone Electric Supply Company is not having things all its own way by any means, and at the meeting of the Marylebone Vestry this evening (Wednesday) the motion again came up for instructing the Solicitor of the Vestry to oppose at all its stages the Bill for confirming the grant of a provisional order to the newcomer. Dr. Fletcher Little further contended that the Vestry's endeavours to acquire powers for the supply of electricity in St. Marylebone may be gravely endangered if the confirmation takes place. The position is growing more and more complicated, and yet more patience will have to be exercised, we fear, before the tangled skein becomes untwisted.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, April 18th.	Closing Quotation, April 25th.	Business done during week ended April 25th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	63 — 66 xd	63 — 66	...	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	115 —116	115 —116	116	115
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	14½— 15	14½— 15	14⅝	14⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	...	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,332,823£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	..	...	102 —104	102 —104	103½	103
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½%	1 %	...	¼— ¼	¼— ¼	...	...
16,000	Cuba Telegraph	10	7 %	8 %	...	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	...	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101 —105%	101—105%	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	11½— 12¼	11½— 12¼	12	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	151 —156 xd	150 —155	154½	151½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —101	98 —101	98½	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	115 —120	115 —120	116½	115
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	16 — 16½	16 — 16½	16⅝	16¼
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	100 —103	100 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	115 —120	115 —120	117½	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	100½	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	...	...	...	101 —104%	101 —104%	101½	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	...	11½— 12	11½— 12	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15½— 16	15½— 16	15⅝	15 9/16
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	...	...	33 — 35	33 — 35	...	...
86,300	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	54 — 58	54 — 58	54	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	...	...	½— ½	½— ½	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	½— 1	½— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	5 — 5¼	5 — 5¼	5¼	5 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5¼— 5½	5¼— 5½	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	97 —100	98⅜	97½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅜— 1	⅜— 1	13/16	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	...	...	102 —105	102 —105	...	...
11,839	Reuter's	8	5 %	...	...	7 — 8	7 — 8	7¼	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129 xd	124 —129	...	...
58,000	United River Plate Telephone	5	5 %	6 %	6 %	4⅜— 5¼	4⅜— 5¼	...	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	97 —100	97 —100	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	100 —104	100 —104	...	...
205,993	Western Telegraph, Ltd., Nos. 1—205,993	10	...	...	...	14½— 15	14½— 15	14⅞	14 9/16
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	105 —108	105 —108	...	...
88,321	West India and Panama Telegraph	10	8%	...	...	¾— 1½	¾— 1½	1	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	...	...	9½— 9⅝	9½— 9⅝	9⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	...	...	7 — 8	7 — 8	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	104 —107	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9 — 10	...	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 5⅝	...	...
34,000	*Chelsea Electricity Supply, Ord.,	5	6 %	6 %	6 %	6½— 7½	6½— 7½	...	..
100,000	Do. do. do. % Deb. Stock Red.	Stock	4½%	...	...	108 —111	108 —111	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	10 %	6 %	4 %	10 — 11	9½— 10½	10⅜	10
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	13	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	122 —127	122 —127	127	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	4 %	9¼— 10½	9¼— 10½	10	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12½— 13½	12½— 13½	...	...
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	109 — 112	109 —112	111½	110
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5½	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock	100	...	...	...	... ...	101 —104	102¾	...
110,000	London Electric Supply Corporation, Limited, Ord.	8	...	...	...	1½— 2	1½— 2	...	...
48,050	Do. do. do. 6 % Pref.	5	...	6 %	...	4½— 4⅝	4½— 4⅝	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½— 14½	13½— 14½	14	13⅞
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	114 —117	114 —117	...	...
125,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	97½	97½
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15½	14⅞
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2¼— 2¾	2¼— 2¾	...	...
50,000	Do. Do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4 — 4½	4 — 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	12 %	13 %	15 — 16	14½— 15½	15⅜	15

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation April 18th.	Closing Quotation April 25th	Business done week ended April 25th, 1900. Highest	Lowest
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	...	...	2⅜— 3½	2⅜— 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
30,000	British Electric Traction	10	...	6 %	...	17 — 18	17 — 18	17⅛	17½
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	12⅜— 13¼	12⅜— 13¼	13⅛	12⅞
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	125½	...
45,000£	†British Electric Works Co., Ord. £1 shares, 50,001—95,000	...	...	...	...	⅞— 1	⅞— 1	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	⅞— 1	1 1/16— 1 1/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	99 —101	99 —101	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6 — 6¼	6 — 6¼	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	3 %	5 %	...	1⅞— 2	1⅞— 2	1⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2⅛— 2⅜	2 — 2⅛	2⅛	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	108 —113	108 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —105	103 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½ %	15 %	...	14½— 15½	14½— 15½	5 1/16	15
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5⅝	5 13/16
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —116	112 —116	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10½— 10⅝	10½— 10⅝	10⅝	10¼
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅞— 5⅛	4⅞— 5⅛	5⅛	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	5⅛	...
855,000	City and South London Railway	Stock	1⅞ %	2⅛ %	1⅞ %	67 — 70	67 — 70	68	...
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000 ...	10	...	...	...	6 — 7	6 — 7	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 102	99 —102	101½	101
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	2 — 2⅛	2 — 2⅛	2 1/16	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	...	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	93 — 95	93 — 95	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	...	2⅜— 3¼	2⅜— 3¼	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	103 —106	104	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13½— 14½	13½— 14½	14½	13⅜
12,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5⅛— 5⅜	5⅛— 5⅜	5⅜	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	...	...	110 —114	110 —114	111½	..
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅝	21¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½ %	3½ %	3½ %	8⅜— 8⅞	8⅜— 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	35 — 39	38	36
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	100½	100
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ...	5	...	...	...	10 — 11	10 — 11	10 5/16	...
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	101 —104	100 —103	102	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 103—105.
National Electric Free Wiring, 12/6 paid. ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17—18.
Do. do. Pref. (£10 pd.), 10½—11.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 %, £5 (fully paid), 6¾—7¼. Debentures, 104—107. Dividend, 1899, on Ordinary Shares 11 %.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (January 25th, 1900).

MARKET QUOTATIONS, Wednesday, April 25th.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	23/-	23/-	..
a „ Oxalic .. .. .. per cwt.	39/-	39/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£34	£34	..
a „ „ „ .. per ton	£31	£31	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 10	£26 10	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	4½d.	4½d.	..
a „ Caustic (75/80 %) .. per ton	£34	£34	..
a „ Bisulphate .. .. per ton	£25	£25	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3½d.	3½d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£80 to £150	£80 to £150	..
c Brass (rolled metal 9" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ „ (solid drawn) .. per lb.	9d.	9d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..
c Copper Tubes (brazed) .. .. per lb.	11½d.	11½d.	..
c „ „ (solid drawn) .. per lb.	11½d.	11½d.	..
g Copper Bars (best selected) .. per ton	£87 10 to £89	£89 to £89	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£88 to £90	£88 to £90	..
g „ Rod .. .. .. per ton	£88 to £90	£88 to £90	..
c „ (Electrolytic), Bars .. per ton	£85	£85	..
c „ „ Sheets.. per ton	£94	£94	..
c „ „ Rod .. per ton	£88	£88	..
c „ „ H.C. wire per lb.	10d.	10d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	8/- to 8/6	8/- to 8/6	..
h India-rubber, Para fine .. per lb.	4/2	4/2	..
i Iron, Charcoal-Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	77/-	78/9	1/9 dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	70/- to 72/6	70/- to 72/6	..
i „ Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 2 6	£17 2 6	..
g „ „ Sheet .. .. per ton	£18 10	£18	10/- inc.
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£9 10	£9 12 6	2/6 dec.
d Mica (in original cases), small .. per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large .. per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet per lb.	From 1/3	From 1/3	..
c Platinum .. .. per oz.	£3 12	£3 12	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/	10½d. to 1/1	..
i Steel, Magnet, ace'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£140 10s. to £141 10s.	£143 10s. to £144 nom.	£3 dec.
g „ foil .. .. .. per lb.	1/9	1/9	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/9	1/9	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	8½d.	8½d.	..
j „ Best Flax, 8 lea. .. per lb.	6d.	6d.	..
j „ Hemp, 2 ply 10 lbs. .. per lb.	4½d.	4½d.	..
j „ „ Russian, 10 lbs. .. per lb.	5½d.	5½d.	..
j „ Jute, 180 lbs. rove .. per ton	£15	£15	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27 5 nett.	£27 5 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Messrs. Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
p Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

ELECTRICAL PROSPECTS IN THE PHILIPPINES.

An American electrical man on the Isle de Panay sends the *Western Electrician* the following interesting article:—

Demands for Apparatus.

During the last few months there has been a great demand for electrical apparatus of all descriptions in the cities and towns in the Philippine Islands. This new demand is only in the natural order of events in these islands since the advent of the American troops. The latter have established garrisons in all of the important cities and towns, and as soon as a section is garrisoned, a large number of American and European contractors and prospectors arrive, and begin drawing up offers and contracts to clean the streets, care for and inspect systems of sewerage which they will build, establish electric light and power stations, &c. These estimates for introducing American ideas of lighting important cities and towns, of establishing electric roads, and Americanising things in general, include the complete establishment of the necessary electrical apparatus for doing the work.

Just as soon as the authorities have gotten affairs so well in hand as to consider and let out these contracts, there will be a great step in the advancement of things electrical in these islands. The people are ripe for this improvement, and will assist in the carrying out of any ideas which tend toward the improvement of methods of long standing. For some hundreds of years, under Spanish rule, the people of the islands had been obliged to get along with the crudest sort of implements, and to be entirely without many of the actual necessities of life.

Craving for Improvement.

But the people of the Philippines are not all of the ignorant classes, even if Spain has failed to advance them in modern ways. Many thousands of the richer classes of natives have for generations sent their sons and daughters to Spain and other countries for an education in the leading institutions of learning. The writer has met with educated men and women here who are as well advanced in foreign ideas as one who has always lived in America or Europe. I have interviewed native men who have received an education in foreign electrical and mechanical schools, while it is common to meet with men who have been trained as engineers or contractors. These people tell the others of the great electrical improvements which are in progress in other countries, and now that the Americans are here and instil the modern ideas more and more into the native mind, it is not at all remarkable that the higher classes of natives are constantly arguing for the introduction of these modern ideas they have heard so much about.

Money for Investment.

In every city and town of the Philippines there are a certain number of rich natives, and these men frequently possess large amounts of money. Many of them control extensive sugar and rice plantations and clear fortunes every year. One rich plantation owner, known to your correspondent, operates 20 plantations, employing hundreds of natives and engaging about 250 head of stock to work his machinery and carry the products to the coast for shipment abroad. This man informs me that he is ready to put $100,000 of American money into electrical enterprises for his country. There are many others who have their gold and silver in idleness, often buried in the basements of their houses, who would gladly invest it for a small return.

Present Machine Shops very Inferior.

There are no electrical working shops in this country at present, but there are in every important city and town from two to a dozen so-called metal working machine shops in which a wide variety of work is done. There is a good deal of repairing of sugar machinery in process all the time, and then the nature of the warring factions here has always required that the metal workers of the country be in condition to forge and grind all sorts of implements for carrying on fighting. In every metal working shop will be seen a pile of bolos, spear heads, &c., in readiness for sharpening or altering. The native smiths are quite expert at making bolo blades, but they are not sufficiently trained to do much fine mechanical work. They have, for instance, sets of dies for cutting threads on bolts and set screws, but the dies are usually out of order, and the threads produced are seldom perfectly true. The native machinist will spend a great deal of time working out a thread on a bolt, and will lose a good part of an hour in tapping one hole in metal. If an American were to come here with the view of establishing electrical working shops, he would find it necessary to bring trained machinists with him. He could hire any number of helpers from among the natives, and would find them to be effective and honest workers, but they could not be depended upon to do only the crudest work, at first, at least.

All Machinery and Tools Must Be Imported.

Although there are already established in the Philippines several well-organised firms for handling metal working, wood working, electrical and even textile machinery, it will be many years before the electrical machinist will be able to procure just what he requires without sending to the United States or to Europe for it. Therefore, the electrical machinist in coming here to go into business should plan beforehand to bring with him every piece of machinery required. With the exception of a few shops controlled by the Government, there is not a place where one can find a complete equipment of planing, cutting, turning or boring machinery.

In nearly all of the shops the native machinist rigs up braces of iron and spends considerable valuable time in boring out a single hole in iron, and nine times out of ten the hole is incorrectly bored. There are no planing tools of any sort, and if a moderate-sized piece of iron is required to be thinned down or trued, a native will have to work it down by hand, sometimes devoting several days' time. There are no turning or cutting lathes, although most of the machine shops have little hand-power wheels for driving a band which circles some wheels which are grooved and which are adjusted to turn pieces of iron and steel for turning down to certain proportions. Sometimes two or three native boys are used to turn the driving wheel and the workman patiently holds his tool against the piece for hours, while the piece is tediously reduced to the desired pattern.

No System.

A prospective electrical machinist might take hold of a local native machine shop and in a few weeks introduce the proper systems for working, and put in the required machinery, so as to make the shop useful to him until he could get one of the regulation kind in service. The native metal workers at present employ no system whatever. Everything seems to be in confusion. The owner of the shop is the foreman, but in doing a piece of work several of the workmen usually stand around and chatter and direct, and disorder prevails in general. They never think of putting their tools away in a rack, but toss them about, and when they are required much time is lost in finding them. Rubbish of all sorts is permitted to collect and get in the way of the workers.

Very Low Wages Paid.

Wages in this country, for even the highest class of skilled mechanical labour, are very inadequate. Foreign machinists who come here, of course, expect the full rates of wages, and if anything more. But instead of receiving offers of $2.50 or $3 a day, they find that the native machinists are working for from 25 to 35 cents a day, American money. If the Government wants a machinist for any of its mechanical work in the Philippines, the regulation rate is paid, but all of the native machinists receive only the low wages of the islands. This fact keeps down the cost of running an electrical establishment in the Philippines, and would operate to advantage to a proprietor who could use a large proportion of the native machinists.

Native Machinists Do Not Work During Heat of the Day.

In the Philippines the weather is very warm about one-half of the year, and so the machinists have been accustomed to lay off during the heated term each day from 11 o'clock in the forenoon until 2 o'clock in the afternoon, during which time they eat their noonday meal and sleep. They begin work at 6 o'clock in the morning and stop at 6 o'clock at night.

Buildings Inexpensive.

A very elaborate building for a power station, electrical working machine shop or other metal industry can be erected in this country at a very low comparative cost. All the buildings for industrial enterprises are ordinarily erected with heavy corner posts, and these immense posts are the mainstay of the entire edifice, for the roof is made of corrugated sheet-tin, imported from England, while the entire sides of the building are light-plaited bamboo and split-bamboo stock.

This kind of a building can be erected on a large scale at a very small cost. The bamboo is worked by the natives very cheaply, and a whole side of a building can be cut, plaited, and set up in place in one day. The stock is lasting, and buildings are standing to-day which were put up many years ago. In the event of fire, of course, the building is doomed, but it is customary to let the building burn, if once ignited, and merely watch out for adjoining property.

Power Plant.

Necessarily the power plant would be steam, for the reason that there are practically no developed water-powers yet in service. The time will probably come when some of the numerous small rivers will be dammed so as to afford a fall of water sufficient to operate turbines, but at present the only reliable power is that obtained by the use of the steam boiler and engine.

Fuel.

Fuel can be secured in abundance from the immense forests and woody growths of the islands. Many of the sugar-mill proprietors have men out all the time collecting the outer husks of the cocoanut, which make good fuel for burning under boilers. Dried stalks of the banana and cocoanut also do good service as fuel when thoroughly dried in the sun.

Electrical Devices Wanted.

Naturally the chief demand at present is for electric railroads for connecting all important centres. A large proportion of the native population is aware of the existence and the usefulness of electric roads in other countries, and they are inclined to favour the adoption of such lines of roads here and would encourage the enterprise by investing money in the stock. Then there are a great many thousand Americans and others here, and many more arriving, for the purpose of going into business here and remaining. All of these people want electric roads and would patronise them. They are also asking for electrical devices. What few electric bells have been put into the houses of the richer natives have attracted much attention. Every native of note who sees the outfit expresses a desire to have electric bells put into his house. With the demand for electric roads, electric bells, and electric light in vogue, it cannot be long before it will be a bonanza to any American who comes here and establishes electrical working machine shops in the leading centres.

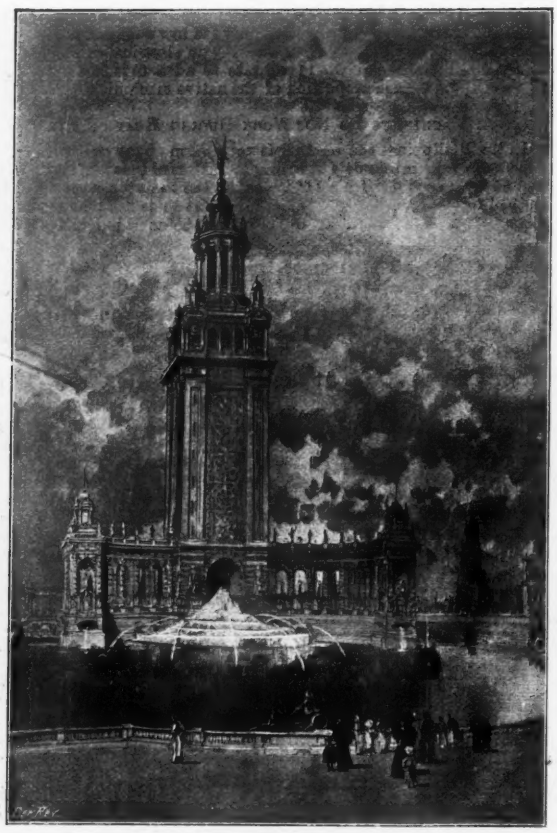
ELECTRICITY AT THE 1901 PAN-AMERICAN EXPOSITION.

By ORRIN E. DUNLAP.

It is estimated that about 7,500 H.P. will be needed to make the electrical features of the Pan-American Exposition a success. This Exposition is to be held on the Niagara Frontier, a few miles from Niagara Falls, in 1901, and already extensive preparations are being made on and about the grounds. The power will be transmitted to Buffalo and the Exposition at a voltage of 11,000, and in the Exposition's principal transformer station it will be stepped down to 2,200, at which voltage it will be sent through insulated conduits to about 200 transformer pits, and from them distributed in subsidiary ducts to points of use at a voltage of 104 and 208.

In every possible manner electricity will be given prominence. No past Exposition or Fair has equalled what will there be accomplished, it being the intention, considering the wonderful amount of current available at Niagara Falls, to make the Pan-American Exposition and its electrical features stand out far beyond what it will be possible to accomplish in any other place not so fortunate in its power possessions. The Electricity Building, the Electric Tower, and the Court of Fountains will long be memorable in the minds of all who are so fortunate as to see them.

The Electric Tower will stand at the head of the Court of Fountains, and as seen from the bridges spanning the artificial lakes it will be most beautiful. Surrounding this tower there will be a



The Electric Tower.

basin having an area of 90,000 square feet. To furnish the material for the tower it is expected will consume about five months, while the erection of the tower will occupy two months or more. The base of the tower will be semi-circular in form, having dimensions 265 by 165 feet. The distance from the ground to top of the tower will be 350 feet. At the height of 70 feet there will be a landing and a restaurant. The second landing will be 200 feet high, the third 253 feet and the fourth 292 feet. Electric elevators of rapid speed will land passengers at the highest landing. In the base of the tower arch-forming columns will rise to a height of 71 feet. The tower will be used for the display of special electrical features, one of which will be a waterfall, 70 feet high and 30 feet wide, plunging from a niche in the tower.

There is every reason to believe that few points in the Exposition will prove so generally interesting as the Electricity Building, for in this structure will be portrayed the latest and highest type of electrical development. Displays of all kinds will be very extensive. This building will be 500 feet in length and 150 feet wide, affording a floor space of 75,000 square feet for exhibits. It is very evident from the applications so far received by the management of the Exposition that manufacturers of electrical goods intend to avail themselves of the facilities of the building. The entrance to the Electricity Building will be very high and wide. Thousands of incandescent lamps will be employed for lighting and decorating purposes, in fact, this feature is destined to be notable.

There is every reason to believe that the International Traction Company will secure the right to operate the intramural electric railway that will skirt the grounds near the fence. All branch roads used in handling exhibits previous to the opening will be covered up and reopened after the Exposition. The intramural electric line will have double tracks and there will be no grade crossings.

So far as possible all distribution of electricity in and about the Exposition grounds will be by underground methods.

The Court of Electrical Fountains will be one of the most beautiful spots on the Exposition grounds. Here the chief electrical displays will be made. In this court over 100,000 electric incandescent lamps of all colours will be used in adding to the brilliancy and glory of the scene. There will be many fountains, and all will be made brilliant at night.

Luther Steringer, of New York, is in charge of the electrical features.

A RETROSPECT OF THE STRIKE OF '97-98.

A rather good review of this notable strike appears from the pen of Mr. Louis Cassier in his own magazine. It is recalled that in April of '97 there was a conference at the Westminster Palace Hotel to settle the differences that had arisen at the Pallion and other works, and that the machine question was not pushed to a conclusion by the A.S.E. By the machine question is meant the right of the A.S.E. to have the operation of all machine tools reserved for their own members. Brought down to its ultimate limit, this claim would prevent a labourer from fettling a casting on a grindstone, which is, we take it, strictly a machine tool as fully as is a lathe or a milling machine.

The machine question was so evidently one outside popular sympathy that the A.S.E. dropped it as a war cry, and nominally challenged the employers on the eight hours' question in London alone. The subterfuge was, however, too transparent; the employers federated on the matter, and the real issue of the struggle was plainly perceived by everyone to be one of domination in the workshops. It was perfectly obvious that the men had no real grievance. The poorly paid clerk, who had done his share to support the dock strikers, in the belief that they were right, could not see his way to support men who earned double and treble his wages, and had no appearances to keep up, in a struggle on which they had entered with no justification whatever. The man in the street, in short, withheld his support, and the strike was doomed to failure from the start, though it lasted through seven months and was largely supported from Germany. We hope that the true meaning of the German support has ere this been rightly appreciated by the men.

We quite agree that the Employers' Federation was not fighting trades unionism, but that it was fighting a few men who had got hold of the A.S.E. and were pulling the strings for objects that were dangerous to the well-being of unionism, and useful only to sound the praises and help on the worldly aspirations of a certain clique.

Mr. Cassier speaks of socialism having insidiously worked its way into trades unionism. There was certainly no socialism in the policy that forbade the so-called unskilled labourer adding to his income by minding machine tools. Our own theory of freedom is that any man who is competent to do a certain thing well is entitled to do that thing, irrespective of his having been trained with a view to doing it or not. We believe in special training, and the specially-trained man should always be able to beat the untrained man of equal ability. But men of greater aptitude may acquire skill with less training. How can it be right to forbid them to exercise their skill?

The strike put a stop, says the author, to the popular delusion that the strikers having demanded everything should be conciliated with something. There is no worse policy than granting sops to Cerberus. A just claim should be granted *in toto*, but an unjust claim does not warrant a partial concession. The A.S.E. had had so many concessions, that finally it became a very Kruger and tried to grab everything, with the result that nothing but war could settle matters. English engineering had become paralysed as the result of the policy of the A.S.E. It was not, to our way of thinking, a question of eight hours but a question of work. Men had practically ceased to work. True, they spent time under the employer's roof, but they certainly did not labour. They were completely demoralised and unsettled.

The author deplores the action of the Board of Trade under the Conciliation Act, and thinks the Board would have done better to collect and distribute information on the hours of labour and rates of wages in the engineering industries of other countries. They entirely failed to do anything. What lesson did the men learn from the strike? This cannot be known, because the working men, as a body, are inarticulate, and no

trust can be placed in the utterances of the professed representatives of labour.

Our own personal knowledge enables us to say that among decent steady men the strike was deplored. They did not want the eight hours—at least, they did not want it unless something could have been done to force the railways into a different scheme of cheap fares. The compulsory early trains would not work in with the opening of the workshops at 8 o'clock. The London County Council and other municipal bodies who have made such loud professions of goodwill towards the working class, have steadfastly opposed every step for the amelioration of the means of transport. Had they been actuated by the virtues they professed to admire, there would have been an electric tramway along every road into London at half the existing railway fares, and the eight hours' question might have been settled, for eight hours is quite a sufficient day for a man who puts his back into his work and does not loaf as he has been compelled to do by the A.S.E.

We need not follow the author into his discussion of what Mr. Barnes, the secretary of the A.S.E., has said since the strike. All know that Mr. Barnes has called aloud that employers should do the very things that the A.S.E. had set its face against their doing. Why, it may be asked, was the A.S.E. wrecked, whereas the Boilermakers, under Mr. Knight's leadership, have been prosperous, and have had no such troubles as the A.S.E.?

Mr. Cassier states that the settlement arrived at after the strike has worked well, and there is no hindrance to employers setting any man to work on anything he is fit to do. We seem to have heard of some trouble, however. Was there not a case of a man in a certain new works in Lancashire being stopped from certain work because of a threatened strike if he were allowed to continue at it? That does not look like settlement, but very like a recrudescence of the worst form of tyranny.

Piecework was recognised as right and proper in the final settlement. Hitherto it had been a cause of much ill-feeling, and had been specially condemned by the A.S.E, which society, indeed, owed its origin as an *amalgamated* society to the avowed policy of abolishing piecework.

On the whole, so far as we can hear, the author is right when he states that the whole industrial welfare of the nation has been benefited as a result of the final stand made against the tyranny of a false unionism. Indeed, the engineering industry was being most seriously handicapped, and the effects of the A.S.E. policy of many years are visible to-day in the many foreign-made engines and machines that have had to be, and still are being, purchased for English tramways and lighting stations. Nevertheless, it may be said that English engineering is now fairly on the way to a new, and we hope, perpetual lease of life; and, without doubt, the English mechanic will still worthily uphold an industry which this country has practically made its own.

GAS ENGINES AND CENTRAL STATIONS.

The gas engine has not been an unalloyed success in electrical stations, and, as we have recently seen, has sometimes been saddled with certain disabilities in the shape of discourteous advocates. These are little if anything worse than the obstacles put in the way of the steam engine in its early days when first set to compete with water-power, and the thermo-dynamic superiority of the producer and gas engine is bound to tell in due time when power users become alive to the economy to be secured. The best steam engines do not change more than 15 per cent. of the heat supplied them into mechanical energy, and boilers rarely give over 80 per cent. efficiency. Gas engines will return 20 and even 25 per cent. The combined efficiency of steam engine and boiler is at best 12 per cent., which may, says Mr. A. D. Adams, whose figures in the *Engineering Magazine* we quote, be assumed as about equivalent to 1·63 lbs. of anthracite of 13,000 B.T.U. capacity per pound.

Coal gas and water gas are not recommended for power purposes. Coal gas only contains 25 per cent. of the energy of the coal from which it is made, while water gas contains about 60 per cent. Hence the combined efficiency of coal gas plant and gas engines is only 6·25 per cent., and that of water gas about 15 per cent. Producer gas contains as much as 80 per cent. of the calorific capacity of the fuel it is made from, and the cost of apparatus exceeds by very little that of boiler plant for equal power. The combined efficiency of producers and engines may thus be 20 per cent. With the same anthracite as above, the horse-power-hour may be obtained with 0·98 lb. of fuel, as against 1·63 lbs. with steam engines. The fuel saving is nearly 40 per cent. But there are other advantages. Producer gas can be made from fuels of a quality quite too poor for steam raising purposes and of a low price. Mr. Adams considers that electric stations have peculiarities rendering them particularly suited for gas power. The load, for example, usually ranges from a fourth to a half of the maximum load, and the changes are rapid, and ordinarily, load may vary from average to maximum in one hour, while maximum load rarely endures for two hours in twenty-four—this of course refers to lighting stations.

The result of all this is not merely that there must be sufficient engine power to carry the maximum load, but that the boilers also must be of the same full power. With producer gas, however, a cheap form of gas-holder will enable the gas producer to be run steadily, and the peak of the load curve will be dealt with by the stored gas. Storage batteries, of course, have been applied to steam-driven stations, to get over the peaks of the loads, but the storage battery is equally applicable to gas-driven stations, and still leaves the above further advantage.

The steam boiler itself is not a great store of energy. The total heat in the water is not a sixth of that necessary to convert it to steam while in water-tube boilers the water capacity is very small indeed. Stored gas contains its energy chemically locked up, and the gas may be stored indefinitely. Gas producers do not cause smoke; they are safe against explosion. Gas engines are claimed to afford better economy than steam engines in their relative performance under the conditions of electric stations.

The saving of one-third the fuel, and the further economy due to the possibility of using very inferior fuels, should certainly offer to power users the necessary inducement to investigate the subject thoroughly. We are bound to say that some gas producers we have seen at work appear to have been put up in singular disregard of all the elements of good work; but this is a fault that belongs to the maker and designer rather than to the system, and we must add that other gas plant has appeared to us practically perfect in its make and method of working.

ADMIRALTY ENGINEERING.

II.

Continuing these articles, the *Engineer* asks at this late hour, "Was it worth while paying £180,000 for the right to use the Belleville boiler?" Our contemporary appears now to think not.

At the time when we stood practically alone in backing Mr. Allan, of Sunderland, who stood up in the House and was bold in his denunciation of the boiler policy of the Admiralty, the *Engineer* sat on the fence and practically placed its authority upon the side of the policy. We are now told by our contemporary that at first it held an adverse view concerning it, but on the publication of favourable statements was "led to doubt the accuracy of first impressions." We are now informed that the tubes for the Belleville boiler are about 90 feet long, made up of 10 rows of 9 feet each disposed in the form of a flattened zigzag. When the experiment of the *Powerful* and *Terrible* was put in hand, we believe that the tubes were 90 feet long, just as they are to-day. Yet with this 90 feet of water pipe joined every 9 feet to a short bit of horizontal pipe and each 9 feet piece at a flat inclination over a fierce fire, our contemporary allowed itself to be drawn out of an adverse opinion on a question of such very serious importance.

It is plainly and obviously wrong on the face of it, and it is curious how on so plain an issue the *Engineer* could permit itself to be put off its original view. It is now perceived that the boiler is unsuitable. Its tube arrangement is not good. According to Sir John Durston himself, it is practically as heavy as the Scotch boilers it displaced. Moreover, it is so liable to pitting and corrosion, and so difficult to repair at sea, that even if it had been of less weight than ordinary boilers, so many of the Bellevilles are laid off, that practically in a large ship there must be excess of boilers in order that full power can be worked.

The evil of pitting from which the Belleville boilers suffer is such that a mere pin-hole eaten through any one tube practically puts the whole of that boiler out of commission until the element is removed and replaced, and while nominally easy of accomplishment the job is really tedious and difficult, compared with the operation of plugging a leaking tube in a Scotch boiler. As is well known, a tube stopper is simply a rod carrying two india-rubber washers capable of being compressed so as to fill the tube. The stoppers contain the burst portion between them, and the burst tube becomes part of the water space of the boiler. A ship may arrive in port with scores of its fire tubes thus plugged, and be very little the worse for the plugging. The operation is simple, and at most only disagreeable to the engineer who does it, because he has usually to stand more or less in the smoke box or base of the uptake, exposed to heat, dirt, and fumes. Belleville or water tubes generally cannot be plugged without first laying off the boiler. The failure, or so-called failure, of the Scotch boiler in the Navy is attributed to the late Mr. Sennett, chief engineer, who believed that he could get more duty out of Scotch boilers than other engineers had been able to do, and he starved our ships in respect of boiler room, and tried to make it up with forced draught. Having got a dubious practice into working order, the Admiralty then find out that Scotch boilers are all wrong, and coming to the conclusion that a change is inevitable, they forthwith, without serious trial or investigation, pay a huge sum to use the water-tube boiler, which the *Engineer*, after bolstering up the Admiralty policy for years, now wishes to see changed. It is by no means certain that the Scotch boiler is the one that should now be adopted. It is an internally fired boiler, and therefore has a limited area of grate, as have all of its type. Externally fired boilers have the capacity of very much larger grate surfaces, but in the Belleville, and we fear in many other water-tube boilers, the full use of this large area is not possible or practicable, because of the priming.

The priming of the Belleville boiler is, we believe, out of all reason, but other water-tube boilers prime less, and it appears to us that if water-tube boilers are to be employed they must be combined with some form of steam dryer or superheater; we might further suggest the employment of a water separator, to be placed in the boiler itself, so as to drop the separated water where it should be dropped,

i.e., into the water space of the boiler. We are bound to say, however, that excepting the failure of the old boilers brought about by the forcing policy of the late chief engineer, there has never been adduced any good reason for the rejection of the earlier type. The *Engineer* makes out as bad a case as possible against the Scotch boiler, and persistently shuts out all mercantile experience as being quite inapplicable to the conditions of warships, because in the latter so much horse-power must be obtained per ton of boiler. Yet it is admitted that the water-tube boilers weigh as much per horse-power as the old boilers, so that had the water-tube boiler proved a success in other respects its weight would have been allowed, and by this same reasoning the Scotch boiler need hardly be condemned.

We think practical marine men will not yet be convinced that the lessons of the mercantile marine can be scouted. Atlantic liners use Scotch boilers, and use them with forced draught. We have seen it stated that in the Navy the boiler failed with forced draught, because the closed stokehold system was used in place of the closed ashpit or Howden's system. This may be so. But are there not Scotch boilers running successfully with closed stokeholds? We believe the *Cambria*, of the Northwall line of the London and North-Western Railway, has Scotch boilers, and she has forced draught and a closed stokehold. Much is heard about the rapidity of getting up steam in water-tube boilers. Obviously the boiler with the least water in it can most quickly get up steam. But there is no good reason why steam cannot be got up as quickly as the fires will do it in the Scotch boiler. The *Engineer* admits that if the water in a Scotch boiler is kept in circulation by a pump—a very easy and simple matter—the fires can be pushed at full speed from the first. Far too much credit has been given to the water-tube boiler, because Cervera's fleet with full steam on, nearly succeeded in running away from the American fleet that was supposed to be blockading it, but which from lack of proper discipline or proper orders was creeping about outside, quite unprepared for a run.

Had Cervera only known it, he might have rammed at least one American ship for each one he lost of his own, for his enemy was comparatively immobile for a time, and could have been run down. But the American ships had no business to have been so immobile under the circumstance that they were supposed to be watching for the Spaniards to come out.

A third article is promised in which the future policy to be followed is to be mapped out by our contemporary. Let us hope that the value of the advice will be greater than the value of the opinions expressed at one time so favourably of the Belleville boiler.

ENGINEERING IN THE UNITED STATES NAVY.

A propos of the position of the engineer in the Navy, it is of interest to read Rear-Admiral Melville's article on the United States Navy in *Cassier's Magazine*. Reference is made to the fact that the question is probably in progress of settlement. It has been more hotly discussed in the United States Navy than it has been here, and was probably brought to a head by the Spanish war. How serious this war might have been at the outset for the United States can only be guessed at. That it was not serious was simply due to the fact that from lack of supplies the Spanish Navy never attempted to fight, and the United States Navy had the very unenviable task of destroying runaway ships, and nearly missed doing this for lack of boilers under steam. The author compares the amalgamation of the engineers and the line with what took place in our own navy under Cromwell, when the sailing master and his mates were amalgamated with the soldiers who did the fighting and evolved the man o' war's man and naval officer. So to-day there is again need to amalgamate the fighting line and the motive power staff in order that the best results may be secured.

The author, is perhaps, more particularly interesting in his remarks on the use of water-tube boilers in the United States Navy. It was considered that shell boilers would become out of date with the increase of pressures, and the result of an attempt to find some fresh boiler, was that about 5,000 H.P. of Ward boilers were installed in the *Monterey*. Observe the experiment. It was on a scale of 5,000 H.P., surely a fair size for an experiment, but representing, we believe, by no means all the boiler power of such a ship as the *Monterey*. Compare it with the 25,000 H.P. of Belleville boilers thrust inconsiderately upon the *Terrible* and *Powerful*, to be followed quickly by about an equal amount on the *Diadem!*

Even after the *Monterey* experiment, progress was cautious. It was felt there had been insufficient experience in the use of the water tube, and shell boilers were still employed in large vessels. To-day, all new American designs include water-tube boilers exclusively—apparently of the Ward type.

This boiler is of somewhat peculiar design. It has water tubes in the form of semi-circular concentric rings connected at either end to a row of vertical tubes or headers. The two rows of vertical tubes that form the headers are placed radially on opposite sides of a central reservoir. The firegrate is circular in plan and the general form of the boiler is cylindrical. The vertical headers open at the top into horizontal collectors which deliver into the central reservoir. At their lower ends the vertical headers connect to similar horizontal distributors supplied from the central reservoir. The curved tubes are slightly inclined, and there are from 6 to 9 different patterns or sizes of semi-circle in one boiler. The Ward boiler in this respect is therefore markedly inferior to the Morrin boiler of somewhat similar ideas in construction, for this boiler has one pattern of bent tube only. Needless to say, the Ward boiler is essentially a clean water boiler. Its many small curved tubes preclude the use of a scaling water. It has no long tubes, but it has a perhaps undesirably large amount of detail, such as stuffing glands. Moreover, the failure of a single tube by perforation would probably lay off the whole boiler.

Also, so far as can be seen from a rather small drawing, the replacement of a tube could not be effected. It is said that the weight of the boilers of the *Monterey* is only ·238 ton per square foot of grate, and that under steam and forced draught it gave satisfaction, but that steam production was limited by the care necessary to prevent the cast-iron grate from falling down—a curious sort of fault surely. The disadvantage of the boiler probably most marked when in good order is its circular grate, which demands two firedoors for proper firing. We do not see any absolute necessity, however, for the two firedoors to be diametrically opposite to each other. It is quite conceivable that as good practice in firing may be made with the doors separated by an angle of 90° or 120°, or that three doors at 120° would be more easily employed than two.

1,000 MILES AUTOMOBILE RUN.

On Monday there started from Hyde Park Corner, at 7 a.m., the automobiles that have participated in the 1,000 miles run arranged by the Automobile Club; the route to be taken being *vid* Bristol, Birmingham, Manchester, Edinburgh, Newcastle, Leeds, and Sheffield. Over 80 vehicles were entered, of which 53 were entered by manufacturers and agents, and the remainder by private owners. Plenty of time is allowed for the run, the survivors only returning to London on May 12, so that the allowance is 19 days, and the average daily run will thus be about 52 miles, not a very arduous task if we compare it with the efforts of a car at Pau, which recently ran 208 miles without a stop at an average speed of 44⅔ miles per hour, and covered the first 34½ miles in 33½ minutes. We hardly know which to admire most, the car, the road on which it ran, or the skill of the driver. However, only 11 days are really to be filled in running, the other days being exhibition days at various towns *en route*. The following hills will be climbed during the journey, and will test the climbing powers of the vehicles, namely, Taddington, Snap Fell—10 miles long from Kendal—(an optional climb this, however), Dunmail Raise, including 80 yards of 6¾ (get out and push her a bit), and Birkhill, near Moffat, which includes 1 mile of 300 feet rise. All these hills are pretty well known historically.

The test, by the way, is to be of endurance, not speed, and no speed beyond the legal limit will be admitted in record as of any value. Vehicles may also be disqualified if their drivers fail to show consideration for restless horses, so there will be some hope of seeing what careful and steady driving can accomplish.

Bristol was fixed as the first day's run of 118½ miles, and there will be exhibitions of the cars at Cheltenham, Birmingham, Manchester, Kendal, Carlisle, Edinburgh, Newcastle, York, Leeds, Bradford, Sheffield, Lincoln, Nottingham, as well as at Bristol, with a final seven days' show at the Crystal Palace on the return of the survivors. Let us hope there will be many. The cars entered include vehicles holding from one to six persons, the one-person vehicles being tricycles, two persons being carried by the larger quadricycle; but many of the cars are of the dog-cart or wagonette class. Foreign firms are at liberty to compete, and have sent vehicles, and the Automobile Club of France has offered three medals. There is also a cup prize, and a bonus of £10 to every car that satisfactorily completes the trial.

THE ELECTRICAL EQUIPMENT OF SHIPS OF WAR.*

(*Continued from page* 644.)

We now come to that section of Mr. Grove's paper in which he deals with the important subject of machinery and power distribution. He divides the machinery of a modern man-of-war into—(*a*) Main propelling machinery, consisting of high-speed steam engines and high pressure boilers; and (*b*) auxiliary machinery, viz, those which co-operate with the main engines and boilers in the propulsion of the ship, those which relate to the operation of the ship as a fighting machine, and those which fulfil domestic functions. In all, a first-class battleship carries nearly 100 sets of machinery, and a first-class cruiser from 50 to 70 sets.

Within recent years electric driving has gradually been supplanting steam and hydraulic power in the working of the auxiliary machines, but Mr. Grove believes that electricity will have no place for many a long day in the propulsion of large ships.

The greatest advancement in the application of electricity is exampled in the U.S. battleship *Kearsage*, which carries 55 motors and a generating plant of 350 KW. capacity. (In

* Condensed from a paper read by Mr. C. E. Grove at the Institution of Electrical Engineers, April 5th, 1900.

a Service paper we have recently observed that this vessel, which has been very much criticised during her trials, is now pronounced an unqualified success.)

Judged by the standard of present-day land practices, British naval designers would appear to be several years more backward than they really are, for a battleship takes about three years to build, and it is not unreasonable to allow a year for trial of any novelty at sea, and four years is a long time in electrical development.

Mr. Grove does not appear to think that our Admiralty can be successfully charged with negligence or apathy in regard to the application of electricity. He points out the difficult conditions which exists aboard ship, and shows that with very few exceptions electric motors should be of enclosed water-tight and dust-tight type, of extra strong mechanical construction to stand overloading, and arranged with long bearings and good automatic lubricators so as to run for long periods with no attention at all; they should also be designed to work sparklessly with constant lead for all loads, so that the brushes are fixed; and, moreover, the brush gear must be so designed that the brushes do not jump off the commutator if the machine is exposed to external vibration, whilst the motors should run for normal periods with moderate temperature rise. All the conditions can fortunately be met to-day; but in Mr. Grove's opinion they are best met by the modern traction type of motor.

A strong case is made out for the advantages of the electromotor over the steam or hydraulic engine, and for cables as a means of transmitting power over p pes, stress being laid upon their convenience and simplicity.

Efficiency.

The mechanical efficiency of an electric motor is, as a rule, a few per cent. higher than that of a steam engine of corresponding power. The efficiency of the system as a whole involves the consideration of the generating and distributing arrangements, and here electricity has a marked advantage over either steam, compressed air or hydraulics, the power taken being strictly proportional to load, and the overhead efficiency from I.H.P. of generators to B.H.P. on motor shafts averaging about 65 per cent. at full load. But the naval architect wants the relative advantage of competing systems in terms of weight and space. Whether the change from steam to electric driving of auxiliaries involves the sacrifice of greater weight than is compensated for by the advantages gained is precisely the question upon which authorities differ, the differences being chiefly due to the use of general terms for the sake of argument instead of precise calculation.

The main sources of loss in operating steam-driven auxiliaries are three:—(*a*) The use of too great a range of temperature and pressure in the cylinders; (*b*) Leakages, part pistons and valves due to wear; (*c*) Steam pipe condensation. Under each of these headings Mr. Grove gives telling illustrations drawn from actual naval practice; he considers that under the last-named is found the most serious source of loss. The arguments for and against are examined, and the author concludes that any appreciable increase in the horse-power rating of electric, as against steam-driven auxiliaries, is unnecessary, and that if the whole of the auxiliaries of a 15,000-H.P. ship were electrically driven, a saving of about 5 tons of coal used in generating the auxiliary steam would result from the suppression of pipe condensation, and (on the rather less basis of 59 per cent. overhead efficiency) a further saving of 56 per cent. of the balance of 10 tons = 5½ tons due to superior mechanical efficiency, a total of 10½ tons out of the 20 tons per day used by a good steam auxiliary equipment. Saving in coal consumption, moreover, means an increase in the ability to keep the sea at economical speed.

The questions next examined are: To what purposes is it practicable, having regard to all considerations, to adapt electric driving, what would be the changes in weight, space, &c., involved, and what should be the arrangement of the installation for supplying the power? There is a broad difference at once to be recognised between machines directly co-operating with the main propelling machinery and those performing other duties. On the whole, present engineering opinion is, from consideration of reliability, decidedly in favour of continued steam driving for boiler feed-pumps, circulating and hot-well pumps, fire and bilge and distiller pumps. Experience with electric auxiliaries in other situations may eventually lead to the use of electricity for these services; but for the present the contingency may be left out of account.

(To be concluded.)

THE UTILISATION OF BLAST FURNACE GAS FOR THE DEVELOPMENT OF POWER BY GAS ENGINES.

The *Practical Engineer* some time ago gave some interesting particulars relating to the application of blast furnace gas to the driving of gas engines.

The statement that only about 60 per cent. of the thermal value of the fuel used in the furnace is utilised in the process of smelting the iron, however, only applies to the conditions obtaining at certain furnaces.

The number of heat units required to be supplied by the fuel in the operation of smelting a given weight of pig iron varies within a comparatively small range for the different classes of pig iron produced and the nature of the ore available, as well as the quantity and class of flux employed, but the conditions of smelting under different circumstances very considerably affect the proportion of fuel required to be charged into the furnace to produce a unit weight of pig iron. Thus the weight of coke necessary to produce 1 ton of pig iron, when cold air blast is employed is, say, 1 ton 18 cwt., while when the air blast is heated, only from 18 cwt. to 1 ton will be required.

The volume of gas evolved from the blast furnace during smelting is not proportional to the weight of pig iron produced, but to the weight of fuel consumed. In the first instance the volume of gas evolved would be about 323,000 cubic feet, measured at a temperature of 60° F., and in the second case 153,000 cubic feet. Taking the thermal value of the gas in both cases, for the difference would not be very considerable, at 100 B.Th.U. per cubic foot we have the thermal value of the gas evolved for the production of 1 ton of pig iron as—

Cold-blast iron	=	32,300 000 B.Th.U.
Hot „ „	=	15,300,000 „

For the thermal value of the fuel charged, at 14,000 B.Th.U. per lb., we have—

1 ton 18 cwt. coke to produce cold-blast iron	=	59,584,000 B.Th.U.
18 „ „ hot „	=	28,224,000 „

from which we see that the evolved gases have a thermal value equal to 54 per cent. of that of the fuel charged, but in the latter case a considerable proportion of the gas has to be burned in stoves for heating the air blast, which proportion of heat is returned to the furnace and utilised in the economical production of pig iron, while in the former case the whole of the gas evolved is available for the development of power, only 46 per cent. of the thermal value of the fuel having been directly necessary for smelting the pig iron; from this it will be seen that there is very much more gas available from cold-blast furnaces. In modern practice, however, it is found that even when applied under boilers for steam raising, and in stoves for heating the blast, there is still a considerable amount of gas to spare, including that which is lost through defective charging apparatus and other sources of waste.

In the report of Prof. Meyer (*Zeitschrift des Vereines Deutscher Ingenieure*) he points out, among the advantages of the utilisation of blast furnace gas in gas engines, the high thermal efficiency of the gas engine. As the thermal efficiency of the steam engine is not much above 10 per cent., while the gas engine gives from 20 to 25 per cent., it will be realised that the substitution of gas engines for steam engines will result in considerable economy as regards fuel, when it is taken into consideration that so considerable a proportion of blast furnace gas is wasted.

Then again, the conditions under which blast furnace gas is employed for steam raising are so far from perfect that it is probable that its efficiency is not very high.

The supply of gas to the boilers is dependent upon the chimney draught, which is controlled by the temperature of the products of combustion. The air supply, as at present

arranged, does not admit of such regulation as to meet all the changes in the pressure of the gas delivered from the furnace, and in the temperature at which it reaches the boiler.

Herr Meyer draws attention to the advantages to be derived from using the gas in gas engines in place of steam boilers, in the absence of danger from explosion, as well as the saving in labour of handling solid fuel where it is found necessary as an auxiliary. Moreover, the heavy liability financially, in cases of accident, renders the use of steam boilers a serious responsibility.

The application of this gas, of low thermal value, to gas engines requires special arrangements to control the ignition, including suitable compression. The cylinders of the engines require to be larger than when a rich coal gas is employed, but not to the extent that might be expected, for in the case of coal gas the proportion of air to gas is about 8 to 1, while with blast furnace gas the proportion is only about 1 to 1, or equal quantities.

The dust usually existing in considerable proportions in the gas can be prevented from entering the cylinders by special apparatus, thus preventing it from coating the internal portions of the cylinder, or causing trouble with the valves, lubricant, &c.

The effects of the variations in the pressure and the temperature at which the gas is given off from the furnace, as well as those of the moisture and dust contained, all of which are considerable disadvantages when burning the gas in boilers, can, by the application of a suitable cooling and cleaning apparatus, in conjunction with an efficient method of drawing the gas through the various vessels, and delivering it to a holder, weighted to give a constant pressure, be neutralised, the gas being delivered to the engine at a determined pressure, and containing only a very slight and regular proportion of moisture, while the density is also constant. The engine tested by Prof. Meyer gave, with coal gas, 80 H.P., while, with blast furnace gas, its capacity was 67, or 16 per cent. less than with the richer gas. The I.H.P. to B.H.P. efficiency was 83 per cent., and I.H.P. to E.H.P., 70 per cent. Higher results than this have been obtained with gas from coke-fed furnaces, even when not at full load.

The number of installations at work and being laid down proves that the advantages of the new system are being rapidly realised and appreciated.

THE EFFICIENCY OF THE DIRECT-COUPLED STEAM TURBINE.

By ED. C. DE SEGUNDO, Assoc.M.Inst.C.E.

The steam turbine is an old friend, and engineers have become accustomed to look upon it as an ingenious reversion to first principles, which, however, could never hope to successfully dodge the conclusions to which theory and science have led engineers in the design of steam engines. The early form of steam turbine, as it appeared at the Inventions Exhibition, is still within the recollection of most of us. It was an entirely new departure, and, owing to its then enormous speed (16,000 to 20,000 revolutions per minute), and the impossibility of applying any of the recognised methods to the measurement of its capabilities, it was rather shelved by most engineers as something which might become of use in special cases, but which was rather too elusive and uncanny to warrant general application.

Since those days, its inventor has spared neither time nor money in his endeavours to introduce the system into practical work. No one will forget the application of the steam turbine to marine propulsion as shown by the performance of the ss. *Turbinia* in 1897. Still, the impression remained that a steam turbine was a steam eater, and that this circumstance, combined with its very high speed, placed it beyond the field of practical application in general.

After some years of experiment the Westinghouse Machine Company have produced a turbine which they claim to be an improvement upon the Parsons' steam turbine, the patent rights of which they acquired in 1896, and they are now at work upon a 2,500 H.P. steam turbine. This is a very much larger unit than has before been attempted in steam turbines, and while the weight and sizes of its individual parts are comparatively large, it is, as an engine, small for the power it will exert. The capacity of the direct connected alternate current generator will be 1,500 KW.

At the Westinghouse Air Brake Company's works three 500-H.P. turbines are coupled direct to 300-KW. alternators. The whole plant, including steam turbines, generators, two 10-H.P. exciter engines and generators, two pairs of condensers and air pumps and the switchboard, occupies a space of 29 feet by 36 feet.

It is stated that the vacuum attained in the condenser is often as high as 28 inches, and the discharge from the condenser is only a degree or two less than the temperature of the steam in the condenser. It is also stated that the temperature of the steam on admission is 350°, and that at a point about 4 feet from where the steam enters the cylinder the exhaust pipe is cool enough to enable one to touch it with the hand comfortably. This is certainly a very remarkable object lesson in the transformation of heat into work.

The exhaust temperature is said to be 102°. The range of temperature between which the turbine works is, therefore, 248°, which is certainly a long one. The Carnot efficiency of such a cycle would be

$$\frac{811 - 563}{811} = 29{\cdot}34 \text{ per cent.},$$

which means that the very most the turbine could do would be to turn into work 29·34 per cent. of the heat contained in the steam supplied. From careful tests it appears that the consumption of steam per E.H.P.-hour was 16·4 lbs. at full load. Now the heat contained in 16·4 lbs. of steam at the pressure corresponding to a temperature of 350° F. is about 19,480 thermal units. The maximum amount of heat that the steam turbine could be expected to turn into work is therefore

$$19{,}480 \times \frac{29{\cdot}34}{100} = 5{,}716 \text{ Th.U.}$$

Now, the work done for this expenditure of heat, namely, 1 H.P.-hour, was 2,565 thermal units, hence the relative efficiency of the combined turbine and alternator was

$$\frac{2{,}565 \times 100}{5{,}716} = 44{\cdot}87 \text{ per cent.}$$

To determine the efficiency of the steam turbine alone, some assumption of the efficiency of the alternator must be made. At full load this may reasonably be put at 94 per cent., from which the efficiency of the turbine alone would work out at

$$\frac{2{,}565 \times \frac{100}{94}}{5{,}716} = 47{\cdot}73 \text{ per cent.}$$

This is a remarkable achievement from the point of view of relative efficiency. The steam turbine has turned into work 47·73 per cent. of the heat supplied to it which it was theoretically possible for it to turn into work, whereas the equivalent efficiency of the ordinary gas engine is 25 per cent., and that of the ordinary steam engine 38 per cent. What is also remarkable in the results of the tests of this combined steam turbine and alternator, is the comparatively small increase in the steam consumption from full load to half-load. The figures given are as follows :—

Full load	...	16·4 lbs. per E.H.P.-hour.
Three-quarter load	...	17·0 " "
Half-load	...	18·2 " "

When the drop in the efficiency of the alternator corresponding to decrease of load is taken into account, these figures show that the efficiency of the turbine itself must vary very little between full and half-load.

WANTED—ELECTROMOBILES!

In a short article which we published last week entitled "Why Should London Wait?" we asked why the largest

and most opulent city in the world should be absolutely devoid of electrical cabs, while New York now had some hundreds plying for hire, and manufacturers were unable to turn out additional vehicles fast enough to satisfy public requirements. The tour of the members of the Automobile Club, to which we allude on another page, has brought to our mind a reason which was given to account for the failure of the electrical cab in London, viz., lack of skilled drivers. It was seriously said that as fast as men were trained to the work of guiding electrically-propelled vehicles through the rocks and shoals of busy metropolitan streets, the owners of private automobiles offered these expert drivers better wages to enter into private service, and so the cab company could not retain qualified men.

This pretext seems too flimsy and transparent to account for the failure to place electrical cabs in the metropolis on a sound commercial basis, and naturally the true reasons must be sought elsewhere; the experience of our American cousins, however, from the driving point of view, may not be wholly uninteresting.

Mr. Hiram Percy Maxim, to whom we specially alluded in our last week's article, declares that 90 per cent. of the skill, care, and expense of the electromobile is required at the place where it is stored, while only 10 per cent. of skill and care is required in the operation on the road. "It is so simple that anyone can operate it, which makes it an especially desirable vehicle for ladies and young persons to use." "Its motor is ideal; its power is stored, and may be used in large or small quantities as desired, and the transmitting devices are of the simplest and most easily managed character."

With gasoline, on the other hand, 90 per cent. of the skill involved is said to be required during the running of the machine on the road, while but 10 per cent. is necessary in the care of the vehicle.

Mr. Maxim was one of two persons who made the record-breaking run in an automobile from Atlantic City to Philadelphia, a distance of 100 miles without changing automobiles, and he is one of the early pioneers in the industry.

At the 204th meeting of the New York Electrical Society, on March 22nd, the entire evening was devoted to a discussion of the status of automobile development as it exists to-day, and several speakers made out the best case they could for electricity, gasoline and steam respectively.

Mr. Riker, whose name is well known on this side, as is his electromobile, said:—"Of all motors, the electric motor requires the least attention in its operation. It has one feature in common with the old 'hay-motor,' commonly called the horse, which is that both of them exert their greatest tractive effort and power at slow speeds, and both of them require no attention on the part of an operator, when they are propelling a vehicle, to make them put forth their best efforts in the ascent of a hill or other situation where these are required. Another feature of similarity and advantage possessed by the electric motor and the horse is overload capacity. It is the nature of the electric motor, even more than that of the horse, to go ahead and do its best until it destroys itself in the effort to provide sufficient power to meet the conditions it encounters. This is not true of any other variety of propelling agent."

Another speaker, Mr. C. J. Field, who apparently held a brief for the hydro-carbon or gasoline type of automobile, yet felt that the electric vehicle was best fitted for purposes of pleasure and of city travel.

Although France is popularly supposed to lead the world in the development of automobile vehicles, just as she does in the scurrilous abuse heaped upon our long suffering old country, yet in the use of the electrical variety of self-propelled carriage the United States undoubtedly is a long way ahead. Our engineers frequently make quiet trips to the other side to study American methods of generator and motor construction, transmission of power plants, electric traction, and what not; why have not New York methods been adopted for the introduction and practical working of electromobiles in the streets of London and other large English towns?

These vehicles are marked by great simplicity and strength, and we agree with our New York namesake that it is not unreasonable to think for city street service that the electrically-propelled carriage has no peer, and again we ask, "Why Should London Wait?"

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

A correspondent inquires:—"Has the National Telephone Company any right to run without leave wires over my garden, and if not, what is my remedy? Am I at liberty to cut them?"

***** It seems that our correspondent has the right to cut wires if they are run through his garden without leave. Or he may sue for an injunction.**

In Levy *v.* The National Telephone Company [the Electrical Review Vol. 41, Dec. 24th, 1897, p. 889], Mr. Justice Day granted a mandatory injunction against the defendants, commanding them to remove their telephone wires from above the plaintiff's house in the Whitechapel Road. It was shown that the wires had been *in situ* for 13 years, and that they caused a nuisance to the plaintiff in the occupation of her house. The Court of Appeal affirmed this decision, Lord Justice A. L. Smith saying that the plaintiff might have cut the wires, but instead of doing that she preferred to bring the action. The right to cut wires was recognised and referred to by Mr. Justice Ridley in National Telephone Company, Limited *v.* Atkinson and Day [the Electrical Review, Vol. 42, March 18th, 1898, p. 367].

Seth Thomas asks:—(1) "Is a patent, taken out by an employé of an electrical manufacturing company, and pertaining to the apparatus manufactured by the company, the property of the company by right? (2) Is a contract binding under the terms of which an employé agrees to make over to the company all patents on apparatus manufactured by the company and which are taken out by the employé during his employment?"

***** In answer to the first question put by "Seth Thomas" there appears to be a direct authority to the following effect:—Where a workman in the employment of a master has made the discovery of an invention, the workman is the inventor and not the master (Bloxham *v.* Elsee, 1 C. and P. 558). This rule applies although the discovery be made in the employer's time and with the use of his materials (Heald's Patents, 8 R.P.C. 430). Anything in the nature of a distinct invention would therefore entitle the workman to apply for a patent, and in the absence of agreement to the contrary, the property in that patent would be in him.**

With regard to the second question addressed to us, there is no legal objection to such a contract. A clause of this kind inserted in an agreement resembles very closely, and would be interpreted in the same way as an ordinary covenant in restrain of trade.

Such covenants are illegal only in so far as they are not reasonably necessary for the master's protection; and no workman could be heard to say that a contract restraining him from using the apparatus, &c., of his master for the purpose of obtaining letters patent on his own account would be unreasonable.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

6,615. "Improvements in terminals and binding screws for electric batteries and connections." W. R. Edwards. Dated April 9th.

6,621. "Improvements relating to electrical switches." J. Sax & Co., Limited, (G. Busch, Germany.) Dated April 9th.

6,637. "Improvements in relays." J. A. Fleming and Marconi's Wireless Telegraph Company, Limited. Dated April 9th.

6,642. "Telephonic device for imitating the sound of guns." C. F. Morris and W. Henley. Dated April 9th.

6,649. "An improved bracket or pendant for electric light and similar fittings." J. Thomas. Dated April 10th.

6,650. "Improvement in telephone switches." C. Petitjean." Dated April 10th.

6,671. "Machine for filling accumulator plates with active material." E. Franke. Dated April 10th. (Complete.)

6,675. "Electrical key or stencel-board contact apparatus for telegraphic communication." E. Baer. Dated April 10th.

6,684. "Improvements in electric coherers." E. Dervin. Dated April 10th. (Complete.)

6,686. "Improved apparatus for forming a silence chamber for telephonic purposes and the like." J. Dewer and B. Sherman. Dated April 10th.

6,693. "Improvements in electric transformers." The British Thomson-Houston Company, Limited. (W. S. Moody, United States.) Dated April 10th. (Complete.)

6,703. "Improvements in electro-magnetic light machines for regulating the sparking moment." T. Bergmann. Dated April 10th. (Complete.)

6,704. "Improvements in induction apparatus." C. Voot. Dated April 10th. (Complete.)

6,727. "Improvements in electric contacts." J. A. Halford. Dated April 10th.

6,728. "Improvements in electric contacts." J. A. Halford. Dated April 10th.

6,731. "Combined telephone exchange and alarm systems." W. L. Wise. (A. Goldstein and J. M. Latimer, United States.) Dated April 10th.

6,748. "A new or improved alternating current electromotor." F. M. Lewis. Dated April 10th.

6,768. "Improvements in the construction of vehicle or car wheels, and in electric motors therefor." C. E. Isbills. Dated April 10th.

6,774. "Improvements in or connected with direct current transformers." W. L. Spence. Dated April 11th.

6,780. "Improved electrical measuring instruments." H. H. Lindon and R. F. Collinge. Dated April 11th.

6,793. "Automatic regulating switch." F. J. Tolchard. Dated April 11th.

6,794. "An improved electrical combined switch and cut-out." A. Eckstein and A. J. D. Krause. Dated April 11th.

6,798. "Double and single-pole maximum and minimum automatic electrical cut-out." S. M. Johnstone. Dated April 11th.

6,826. "Improvements in switches for electric currents." J. C. de Janisch. Dated April 11th.

6,858. "Improvements in the manufacture of electric cables, more particularly intended for conducting currents of high tension or voltage." M. Mildner. Dated April 11th. (Complete.)

6,866. "Improvements in or connected with electricity distribution on the multiple voltage system." W. L. Spence. Dated April 12th.

6,878. "Improvements in electric arc lamps." H. V. James. Dated April 12th. (Complete.)

6,913. "Improvements in electrical speed indicators." The British Thomson-Houston Co., Ltd., and F. Holden. Dated April 12th.

6,918. "An improved electric typewriter." W. C. E. Faber. Dated April 12th.

6,923. "Improvements in loud-speaking telephones." C. F. Dussaud. Dated April 12th.

6,931. "Improvements in or connected with the transmission and distribution of electricity." J. G. Lorrain. (F. Bedell, United States.) Dated April 12th.

6,936. "Improvements in switches for electrical circuits." E. F. Moy and Ernest F. Moy, Limited. Dated April 12th.

6,947. "Improvements in dynamo-electric machines." B. G. Lamme. Dated April 12th. (Date applied for under Patents, &c., Act, 1883, Section 103, February 24th, 1900, being date of application in United States.)

6,948. "Improvement in polyphase induction motors." B. G. Lamme. Dated April 12th. (Date applied for under Patents, &c., Act, 1883, Section 103, September 14th, 1899, being date of application in United States.)

6,951. "An improved instrument for measuring electric currents." L. J. Steele. Dated April 12th. (Complete.)

6,974. "An improved system or means for controlling or regulating electrical installations." W. P. Thompson. (C. Coerper, Germany.) Dated April 14th.

7,031. "Improvements in electric clocks." H. H. Lake. (W. J. Dudley, United States.) Dated April 14th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

8,371. "Improvements in electro-magnets." M. Bouchet. Dated April 7th, 898. For the purpose of obtaining a uniform effort during the whole stroke of the magnet core, it is provided with a hollowed-out end or is otherwise made of decreasing section. By varying the form of the opening the effort may be modified at any given point. The coil is enclosed in an armouring of magnetic metal o the ends of which are fixed two pole-pieces, the lower of which may be extended inwards. Several coils may be wound side by side, and brought successively into action by a moving contact connected with the core. A number of cores may also be connected together in line. An alternating rectilinear movement may be obtained by acting alternately on the two ends of the core by means of a pair of coils. 1 claim.

8,391. "Improvements in high-tension transformers and induction coils for Rontgen ray work and for other purposes." A. L. Davis. Dated April 9th, 1898. Relates to induction coils for Röntgen ray work, &c. The primary coil is wound on a core and enclosed in a tube. The secondary is formed of a number of sections, each enclosed in a cell formed preferably by combining two flanged discs of insulating material. A coil of wire is placed on the flange, then a washer, next a second coil wound in the opposite direction, and finally a second flanged disc forming a cell or reel. The ends of the tube are screwed into insulating supports, insulating blocks being first fitted in position. The spaces so formed are filled with insulating material. 4 claims.

8,495. "Improvements in electric switches and fuses." J. McFarlane and Holland House Electrical Manufacturing Company, Limited. Dated April 12th, 1898. Switches and cut-outs are fitted with insulating or dividing pieces hinged or otherwise adapted to fall by gravity or under the action of a spring between the contacts or terminals when the switch or cut-out is opened or moved. This dividing piece may also serve as an indicator in the case of fuses. 2 claims.

8,584. "An automatic switch for electric cooking utensils." F. J. Down and J. Lok. Dated April 13th, 1898. Relates to means for preventing overheating in electric cooking utensils. A switch controlling the circuit is connected to a float, so that when the liquid sinks below predetermined level the circuit is broken. The switch contacts are connected by a spherical or like conductor supported on a sliding rod which is connected by a link to the float lever. When the liquid falls below a predetermined level, which is regulated by the back lash of the link and by the chain, the contact is withdrawn from between the contacts. 2 claims.

8,884. "Improvements in the mode and means for making the junctions of tubes or pipes which are also applicable to telegraph posts and other similar purposes." J. Spencer, T. H. Spencer, and H. S. Smallman. Dated April 16th, 1898. Relates to the junctions of tubes and pipes which are applicable to telegraph poste, conduits for electric conductors and similar purposes. The wrought-iron or steel tube is first enlarged and then tapered at the end and fits into the tapered socket in the base of a telegraph post. A modification consists of a junction piece screw-threaded internally or externally, and is used to connect large tubes to small tubes, which are correspondingly screw-threaded. The tube ends may be flanged, a right and left handed screw-threaded ferrule drawing the sleeves against the joint, or the sleeve may be flanged and bolted together. A butt joint may be used, tapered sleeves being driven into the ferrule, this form being specially suitable for conduits for electric conductors. 8 claims.

8,910. "Improvements in or relating to electrostatic machines." La Societe A. Cehendet et Cie and P. Archot. Dated April 16th, 1898. (Date claimed under Patents Act, &c., 1883, Sec. 103, November 22nd, 1897, being date of application in France.) Relates to influence machines. The revolving part of the machine consists of a series of metallic discs or rings, &c, each of which is divided into a number of insulated sectors, separated from one another by air spaces. These sectors are carried by conducting bars mounted in insulating supports on the shaft. The inductors preferably made of tin foil, cemented to insulating material and covered with varnished paper, are supported by a number of cross bars secured to insulating brackets. The charge is collected by a pair of rubbers or brushes bearing on the conducting bars at one end thereof, while a second pair of rubbers at theopposite end serve to charge the inductors. When the machine is to be used for producing successive discharges such as are required for igniting the explosive mixtures in a gas or oil motor, a condenser may be added, and discharging balls interposed in the conductors leading therefrom. All the parts may be arranged in an airtight box, provided with means for drying the air inside it, and for decomposing or absorbing the ozone produced. 6 claims.

8,920. "Improvements in trolley poles and standards for electric traction." Siemens Bros. & Co., Ltd., and F. Ayton. Dated April 16th, 1898. Relates to collectors. The trolley pole is pivoted in the head which is extended downwards in tubular form in the standard in which it is supported by bearings. The tail end of the pole is connected to the spring which lies in the tube and has its tension adjusted by the bolt. The conductor is carried down the centre and connected to an insulating ring which rubs on the fixed brush. 1 claim.

8,932. "Improvements in electrical vibrators for telegraphic and other purposes." T. Harvey. Dated April 18th, 1898. Vibrators for siphon recorders and other electrical instruments are formed with a base carrying an anti-sparking coil surmounted by a magnet. The base is also provided with a screw-regulated slide for carrying the vibrator rod and the contact shaft. The rod passes through clips and is adjusted in length by a rubber or other pinion bearing against the part of the rod passing through the slide. A contact spring is carried by the lower clip for the rod. The contact rod is adjusted by a worm wheel and pinion so as to move backward and forward without rotating. 1 claim.

8,988. "Improvements in electrodes for accumulators." C. Alker and P. Mennessier. Dated April 18th, 1898. The positive plates are made up of one or more strips of metal, each of which is provided with perforations and cup-shaped depressions. Each strip is folded on itself so that the cups in adjacent layers do not come together, and if there is more than one strip they are interlaced. Two such interlaced strips insulated from each other may serve as the positive and negative plates. The plate is bent or corrugated and provided with openings, and with stuck up pieces for holding the active material in place. The connection between the electrodes is made by a rod, which passes through an electrode and has at its upper end a mercury cup in which engages a conical piece secured to a conductor connected with the next electrode, and held in place by a rubber ring stretched over and under pins on the piece and rod. 4 claims.

9,002. "Improvements in or connected with apparatus for the manufacture of potassium chlorate or sodium chlorate by electrolysis." J. Brock and the United Alkali Company, Limited. Dated April 18th, 1898. Relates to the electrolytic apparatus for the preparation of potassium and sodium chlorates described in Specification No. 15,396, A.D. 1893. The metal cells forming the cathodes are arranged on terraces so that the liquid can overflow from the top cell to the bottom one through tubes. Each cell is provided with a porous lining and with a platinum anode. The cells are connected up in series. By this arrangement any single cell can be removed without disturbing the others. The liquid from the last cell is withdrawn, and if potassium chlorate has been used as the electrolyte, is run into vessels to allow the potassium chlorate to crystallise out, but if sodium chloride has been used it is boiled down, and the sodium chloride which salts out is removed, leaving the sodium chlorate in solution. 1 claim.

9,105. "Improvements in apparatus to be used in connection with the electro-deposition of metals." T. Greenfield. Dated April 20th, 1898. Relates to apparatus for plating small articles, such as parts of velocipedes, and principally intended for depositing nickel, but may also be used for depositing copper, silver, brass, tin, &c. Consists of an electrolytic tank with anodes, and a cage for carrying the work and serving as a cathode. The cage consists of insulating end discs and central cross discs, joined by two sets of removable conducting rods arranged in slots in the peripheries of the discs, and making contact with conducting end plates which are in connection through the insulated journals and the insulated hangers with the current conductor rod. The work is either strung upon the rods or wired or otherwise attached thereto, insulating blocks preventing any two adjacent articles from touching. The cage is rotated by a belt driven by a pulley on a countershaft. 2 claims.

9,178. "Improvements in electro-motors." J. T. Robson, C. H. Marsden, and H. W. Headland. Dated April 20th 1898. Two motors are mounted on a shaft and a surrounding frame to drive these oppositely. The armature and commutator of one motor, and the field magnets and casing, and the brushes of the second motor are fixed on the shaft. The armature and the commutator of the second motor are mounted on a sleeve attached to the casing and field magnets and brushes of the first motor and to a sleeve. The shaft and sleeve each carry four rings in contact with stationary brushes, and in connection separately with the brushes and field magnets of the motors, so that these can be connected in in series or in any other order. The end of the casing is made in halves and bolted together. The casings may be closed or open. The armatures may surround the fields. The shaft and sleeve can be extended to carry two screw propellers for a boat. The sleeve may be geared to a countershaft, and this and the shaft carry chain wheels for propelling a motor car; or the shaft and sleeve may carry pinions driving internally and externally toothed wheels on a motor car. 4 claims.

9,197. "Improvements in and relating to telegraphic transmitting apparatus." F. G. Creed. Dated April 21st, 1898. Perforating apparatus for preparing paper tapes for automatic telegraph transmission is arranged with a number of key levers, and spread out fanwise at the front where they are provided with keys. The rear ends are parallel and act on L levers. The vertical arms of the levers are provided with selecting notches and projections which act on a number of slide rods provided with reduced ends. The ends control a corresponding series of vertical rods which operate the selecting rods either directly or by means of the pins and pivoted levers, and also on the heels of the pivoted levers in connection with the spacing mechanism. The rods when moved by the levers, project over the heads of their respective perforating plungers, and so form rigid connection with the block, which is connected by the rod with a double-acting compressed air, &c., piston. The lower ends of the rods rest in the upper block of a pair of perforating die blocks, between which the tape is passed. The tape is provided with a central row of spacing perforations in which pins moving on a guide rod can engage. The rod forms part of a pivoted frame actuated by rods attached to the spacing frame which underlies the key levers. The slide on the rod is moved as far as the first lever which has not been raised, and the pins engage with the spacing perforations to that extent, and after the character has been perforated, the slide is drawn to its forward position, carrying the tape with it by means of a lever operated by an auxiliary double-acting compressed air, &c., piston. The rod of the spacing mechanism is continued to operate the valves of the air, &c., engine. The spacing mechanism is provided with means for combining two characters together without an intervening space, and for allowing a single or double space. Modified forms of some of the details are described in both complete and provisional specifications. The provisional specification also refers to the omission of the levers, the key levers acting directly on the selecting rods. 18 claims.

9,216. "Improvements in secondary batteries." G. E. B. Pritchett, T. W. Pritchett, and A. G. Gold. Dated April 21st, 1898. Relates to a method of mounting the plates or electrodes so that a battery or section of plates may be built up before leaving the manufactory ready for placing in the containing cell, and at the same time to provide means whereby the plates of one polarity may be readily removed from those of the other polarity, and also to prevent short circuiting by the materials which accumulate at the bottom of the cell. The end plates and sometimes some intermediate plates are extended in width at the parts, and in length at the part, and these parts are united together by cross bars of lead. The pieces serve as feet and also as supports for sheets of glass on which the intermediate plates or electrodes are suspended by projections. Spacing pieces of ebonite are placed between the plates. 6 claims.

9,466. "An electric switch." P. H. Brant. Dated April 25th, 1898. Switches for controlling a number of circuits such as for lighting lamps, ringing bells, starting motors, &c. A rotary barrel is fitted with a number of arms carrying contacts adapted to engage with fixed contacts mounted on the base or board. The number of arms and of the contacts is varied in accordance with the purpose for which the switch is to be employed. 3 claims.